PRIMA'S OFFICIAL GUIDE TO

Jane's
COMBAT SIMULATIONS

F-15

PRIMA'S SECRETS OF THE GAMES

Spohrer, Tyler, Frase

PRIMA'S OFFICIAL GUIDE TO

Jane's®
COMBAT SIMULATIONS

F-15

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An IMGS, Inc. Production

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HOW TO USE THIS BOOK

The goal of this guide is to provide help/advice/information to players of all levels of experience. Not all of this information is going to be useful to everyone. Below, you'll find a summary of what's covered in this book.

Training Missions are flythroughs of the training missions available in the game — with more detailed instructions for each step, and advice on expanding the learning experience and applying it to actual missions. This section is primarily for players who are novice flight simulation pilots.

Mission Types discusses the most common types of missions assigned in the game in detail, including goals and conditions for each mission type, a fly-through of an example Single mission, and Playtester Tips to help you become an expert.

Campaigns describes the scenarios for both the Iraq and Iran campaigns — including a **Desert Storm Timeline**, which outlines the situation in Iraq, and an explanation of the political/military situations that will dictate course of the Iran campaign.

Mission Prep and Ingress/Egress consists of excerpts from the Air Force's "3-3" F-15E combat fundamentals manual concerning mission preparation and air-to-air combat strategies that are applicable to the player. These are useful during multiplayer.

Air-to-Ground Combat consists of two sections: a tips section on weapons and delivery, and excerpts from the Air Force's "3-3" F-15E manual. The excerpts cover night flight, low-altitude flight, mission planning, and in-depth direction on the entire process of hitting your target.

Game Mechanics details F-15's stats and damage system. See p. 198 for a complete, detailed list of the charts, tables and other material in this chapter.

F-15E Strike Eagle is all the information you'll ever need about your aircraft, its avionics and its weapons, including its **History** and full **Jane's Specifications**.

Appendices include:

Glossary	The complete list of glossary terms from the "3-3" F-15E manual. These terms are used frequently throughout this book and the game.
Inflight Calls	Definitions of some of the more esoteric jargon used in WSO, flight and aircraft radio calls.

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TRAINING MISSIONS

OVERVIEW

F-15 features 16 training missions designed to teach you the basics of flight, air-to-ground engagement, air-to-air engagement, using the aircraft's defensive systems, refueling and using your wingman. This chapter gives you a detailed step-by-step flythrough for each mission.

In these flythroughs, we've expanded on the information given in the game's tutorials with an in-depth description of what to do at each step. In some cases, we've added our own additional steps and suggestions. These are listed in parentheses.

Note: *In this section we assume that you will be flying the missions in Expert mode. If you are flying in Casual mode, the steps for selecting weapons, designating targets, using the TEWS, etc. will be different, as you will see from the instructions that appear onscreen.*

The training missions are a great first step in making the switch from Casual to Expert mode — see ***Moving from Casual to Expert Mode****, p. 13.*

Mission Thumbnails

Mission Name	Description
Takeoff and Nav	Practice taking off and navigating through waypoints.
Landing	Practice landing.
Flight Graduation	Review of the two missions above.
Strafing	Fire your M61A1 at aircraft parked along a runway.
Unguided Munitions	Drop Mk 82s on a building complex.
Guided Munitions	Fire AGM-65s at a building complex.
A/G Graduation	Additional practice using the three weapons above.
A/A Guns	Engage aircraft, using your M61A1.
Sidewinder	Engage aircraft, using IR-guided AIM-9s.
AMRAAM	Engage aircraft, using radar-guided AIM-120s.
A/A Graduation	Additional practice using the three weapons above.
TEWS — SAM & AAA	Learn how to use the TEWS to detect SAM and AAA sites.
TEWS — Aircraft	Learn how to use the TEWS to detect enemy aircraft.
Inflight Refueling	Practice refueling from an airborne KC-135 tanker.
Wingman Ground Target	Practice directing your wingman to engage different ground targets.
Wingman Air Target	Practice directing your wingman to engage air threats.

TRAINING TIPS

General

- If you find you can't bank or pitch all the way in a certain direction, you may need to re-calibrate your joystick:
  - Press [Esc] and [Enter] to exit the mission.
  - Exit the game entirely, and return to *Windows 95*.
  - Go to your Control Panel. (Select START, then SETTINGS, then CONTROL PANEL.)
  - Double-click on the GAME CONTROLLER icon.
  - There should only be one joystick listed, and it should be highlighted.
  - Click on the PROPERTIES button.
  - Click on CONFIGURE, and follow the instructions.
- Your loadout for all of these missions consists of:
  - 1 AN/ALE 40 (60 chaff/90 flares)
  - M56A3 gun ammunition
  - AN/AAQ-13 navigation pod
  - 2 AIM-120s
  - 2 AIM-9s
  - 12 Mk 82s
  - 2 AGM-65s
- If you want to gain experience using weapons other than the ones listed above, you can select a training mission to fly and then choose ARMING from the *Briefing* screen. Click on the CUSTOM button to customize the default load-out. We've listed some examples on the following page.
- You may discover that the A/A and A/G weapons training missions are rather easy. That's because in general, dropping or firing the weapons isn't the hard part — it's finding the targets (and staying alive in the meantime). Once you've gained some experience with the weapons, create a few Instant Action missions with lots of enemies and get used to using the weapons while under attack. Then take a stab at the single missions, where it will be harder to find your targets. The **Mission Types** chapter of this book discusses the Single missions and how to find targets in them.

Mission Variations

To create these variations to the training missions, select the mission listed, then create a custom loadout before you take off, loading the weapon(s) listed.

"AMRAAM" with AIM-7s

AIM-7s figure prominently in the default loadouts in this game, so you'll want to learn to use them. The biggest difference between the two is that when using an AIM-7, you absolutely must keep a radar lock on your target until the missile hits it. If you break the radar lock, then the missile loses its target.

"Guided Munitions" with GBU-15s or Paveways

The Guided Munitions mission focuses on the AGM-65. However, even though Paveways and GBU-15s are also guided weapons, procedures for dropping these weapons are totally different from the procedure for firing an AGM-65. You'll want to practice with all three types of weapon.

Fly the mission as before, but use the instructions on pp. 4.66-69 of the *Expert Flight Manual* to practice dropping GBU-15s and Paveways.

"Strafing" with Durandals

These unguided air-to-ground weapons are designed to take out runways. After a Durandal is released, a small parachute unfolds from the weapon, retarding its descent. As the weapon nears the runway, a propellant fires, driving the warhead below the runway's surface where it explodes.

When flying the mission, make the run as you did before but target the runway instead of the aircraft on it. Release your Durandals instead of firing your gun.

"Unguided Munitions" with Mk 82 AIRs

The Mk 82 AIR was designed to be dropped from low altitudes. Its fins retard the bomb's flight, giving you more time to get out of the way before it impacts. Make your approach as you did before, but from a much lower altitude.You will want to use AUTO bombing mode at low altitudes instead of CDIP (which is the default mode for this mission). See **Select a Bomb Mode**, p. 4.61, and **AUTO Bombing Mode**, p. 4.62, in the *Expert Flight Manual* for instructions.

Moving from Casual to Expert Mode

Training missions are a great way to "graduate" from Casual to Expert mode. As you may have discovered, the game interface isn't different — you select missions, load your plane, read your briefing, etc. in exactly the same way in both modes. The real differences become evident in flight.

Customize

Instead of jumping straight from Casual to the Expert, you may want to create a custom gameplay setup. Go to the OPTIONS menu (click on the moving ball in the center of the pre-game screens), then click on the radial button next to CUSTOM, then click SETTINGS. The effects of most of these settings are straightforward.

Differences in Avionics

The radar and TEWS function differently in the two modes. The numbers in parentheses give pages in the *Expert Flight Manual* that discuss the new features.

Air-to-Air Radar. In expert mode, there are seven additional search modes (4.20) and you can set scan limits (4.21). You may never need to use these features. However, a new tracking mode — Track While Scan — can actually make life easier by allowing you to track more than one target at a time (4.30).

Air-to-Ground Radar. In Expert mode, ground targets aren't marked on the radar returns, and targeting maps (called High Resolution Maps) aren't made automatically. Finding ground targets can be *much* harder in expert mode (4.51-8).

TEWS. The TEWS displays threats differently in the two modes. Perhaps the most importance difference is that in expert mode, *only threats actively using radar are displayed*(4.23). Countermeasures are handled differently as well (4.25).

Differences in Weapons and Targeting

There is no CHANGE WEAPON key in Expert mode! This isn't really that big of a deal because you change your avionics settings with the master mode key (M, 2.3) and you can select A/G weapons from the A/G Arm page (4.59). (You can't select A/A weapons, however (4.34).) Likewise, there is no CHANGE TARGET key. You will have to designate targets by clicking on the radar screen (4.28 and 4.56) or using auto-acquisition modes (4.28, in A/A master mode only).

Note: *Set your controls to"Expert" (via the Controls screen) if you change avionics.*

TAKEOFF AND NAV

Add full throttle. — *Press [+]*

- Your F-15E starts off at 60% throttle if you are using the keyboard to control throttle. (This is indicated by THRUST 60% in the lower left of the HUD.) If you are using a throttle device, there is no default throttle setting.
- You can either go immediately to full power by pressing [Shift][+], or get there in increments by pressing [+] eight times. Each press increases your throttle power by about 5%. If you are using a throttle device, push the device to the 100% throttle setting.
- Of course, nothing will happen until you release your brakes.

Release your wheel brakes. — *Press [B]*

- You'll start to head down the runway. At this point you don't even have to steer — just let the F-15 build up speed.

Pull the nose back at 180 knots. — *Pull back on the stick*

- Your airspeed (in knots) is the number in the box on the left of the HUD. If the plane does not leave the ground when you pull your joystick back, you probably need to reconfigure your joystick.

Raise your flaps and raise your landing gear. — *Press [F]*

- Your F-15 flies much better without the additional drag of the landing gear and extended flaps.
- Keep your nose fairly high, at around the 30° line on the pitch ladder, until you reach an altitude of 10,000ft. (Altitude is the number in the box on the right.)
- At 10,000 feet, center the velocity vector (-o-) on the horizon (0° on the pitch ladder).
- At the top of the HUD is a "heading scale." It marks off compass directions — 09 is east, 18 is south, 27 is west and 36 is north (shorthand for 90°, 180°, 270° and 360°). Notice the solid line (*command heading bug*) right under the 09 mark. It indicates the heading to your current waypoint.

Bank to the right to align the command heading bug on the heading tape (top of the HUD) with the ^ caret.

- When the command heading bug moves to the side of the heading scale, you'll need to bank the plane to re-center the bug under the caret. (The caret indicates your aircraft's current heading.)

  To bank, move your joystick to the right until the pitch ladder (the moving lines in the center of the HUD) is almost vertical. Then pull back on the joystick until the solid line on the heading scale is centered in the caret.

- Once you're pointing in the right direction, move the joystick back to the left until you are flying level again. It will probably take some adjustments, but only minor ones — a small tilt to one side and a small tug back on the joystick.

- If the screen seems to dim as you turn, you are pulling back too hard on the stick. Too sharp a turn angle will force the blood from your head, causing a "blackout." (Later on you might experience "redout" when a maneuver forces the blood to your head, making everything red.)

- Once you are pointed directly at the next waypoint, check your altitude. Did you drop much below 10,000ft?

Follow the waypoint until it switches to the next one.

- When you have the command heading bug in the correct position and have leveled your wings, you may want to hit [A] to activate the autopilot. If your wings are fairly level, the autopilot will maintain your current heading.

  Keep an eye open to make sure that you aren't losing altitude, heading toward an obstacle, or passing up the waypoint.

  You can set the autopilot to maintain your current altitude by calling up the Autopilot submenu of the UFC (clicking on PB 9 — the one with ALT ... next to it), then clicking PB 4 (ALT HOLD). The Autopilot submenu is discussed in detail on p. 2.70 of the Expert Flight Manual *that came with your game.*

Continue to follow all waypoints until the mission is concluded.

- There are four in all. When you receive a message saying that the mission is complete, press [Esc] and [Return].

LANDING

Landing can be one of the trickiest aspects of flying an F-15E. Although it's a good thing to know how to land, it shouldn't upset your enjoyment of the game. If you tend to do fine during the missions, but keep crashing at the end, go ahead and turn REALISTIC LANDINGS off on the OPTIONS menu.

The secret to landing is to first head in the right direction (i.e., toward the landing strip), then line up evenly with the landing strip, flying slowly enough that you can stop yourself and low enough that you don't overshoot or try landing at too steep an angle (which is called *crashing*).

Throttle back to reduce speed to 200 knots. *Press* [-]

- Reduce the throttle percentage to 25%. You'll notice that cutting the engine back doesn't slow you down significantly. That's probably because your nose is pointing toward the ground, and you're coasting ... you might even be gaining speed.
- There are two ways to significantly slow your plane down. One is to pitch the nose of your plane up. The other is to apply your speedbrake ([S]).
  - *Pitch nose up.* If you really need to slow down, and slow down fast, pitch upward as much as 40° on the pitch ladder. This makes it harder for air to flow over the wings and forces your plane to slow down. When you reach about 250 knots, lower your nose until you can see the landing strip.

    Yes, it is dangerous to use the flightstick to slow down, but at the start of the tutorial you are going too fast and accelerating. First priority is to slow down; otherwise, you'll overshoot the island. Of course, if you are over the airstrip already (or even close to it) it is too late to try slowing down enough to land. Just keep on going, and circle around for another try.
  - *Speed brake.* This is for more precise braking. Speed brake is a single flap located behind the canopy, which angles upward and generate a considerable amount of drag. If you need to lose 10-50 knots, extend the speed brake to create drag, then retract the speed brake off again. Don't forget and leave it extended though — you might run out of speed before you reach the runway. The SPD B on the far right of the console is lit when the speed brake is extended.

Enable ILS and line it up to create a cross. *Press* [L]

Don't let the Instrument Landing System confuse you! The ILS is a precision tool, and is most useful when you are close to the landing strip. In fact, it is entirely possible to land without seeing the ground, using only the information from the ILS, airspeed indicator and altimeter. However, the ILS isn't absolutely necessary. During the initial part of your approach, it's best and easiest just to fly toward the strip ahead of you.

- The waypoint prior to the airport is intended to get you lined up with the landing strip, so you'll be headed in the correct direction. When you see the strip, steer for the leading edge ... and turn on your ILS for backup information.
- As you approach the landing strip, you'll notice that the horizontal glideslope and the vertical steering bar almost forms a cross in the center of the HUD. The closer these two lines are to forming a cross, and the closer this cross is to being centered on the velocity vector (-◇-), the better you're doing. This should happen automatically as you steer toward the airstrip.
- When it comes right down to it, though, if you're approaching the leading edge of the airstrip with an airspeed of 200 or below, and at a gentle angle, you're doing just fine.
- By the way, don't forget to use your rudders ([<,] and [<,]) or rudder pedals to fine-tune your direction.

Lower the flaps and landing gear. *Press* [F] *and* [G]

- You'll notice that if you try to lower the landing gear while going too fast, nothing will happen. Slow down, then lower your landing gear.
- At this point you'll want to keep a sharp eye on how much altitude you are losing. Try not to drop below 500ft until you can see the yellow stripes on the runway. If you're losing too much altitude, make sure your speed brake is retracted, crank up your throttle and pull your nose up.

Apply speed brake and wheel brakes upon touchdown. — *Press* [S] *and* [B]

- When you are passing over the yellow stripes at the leading edge of the airstrip, you should be traveling nearly level, very close to the ground (around 7 to 40ft), and about 100 knots. Double-check that your gear is down (the GEAR light on the left of the console should be lit.) Hit the speed brake and wheel brakes at this point, push the nose of your Eagle up a bit, and then let go of the stick. You should drop onto the runway at this point. Don't forget, the runway is a bit higher than sea level.

(Any landing you can walk away from is a good landing.)

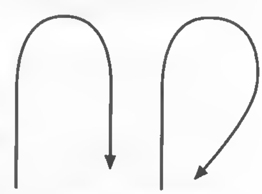
The goal, of course, is to make a perfect landing on the runway. If you miss the runway, it's not a catastrophe, just a bumpy ride. If the word CRASHED doesn't appear, you did just fine.

You might be going faster than you'd like. Even a speed of 150 knots or more is possible, as long as you don't hit the runway at a nose-down angle.

(When in doubt, do it again.)

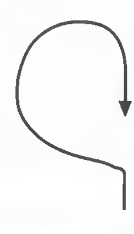
After you go through a dozen successful landings, you'll get a feel for when a landing is going to work. If you sense that it's not, punch your afterburner ([\]), pull your nose up, and circle around for another attempt. (Don't forget to turn off your afterburner ([\]) when you get up enough speed.)

An F-15's turn radius is not a small one. You'll notice that if you try to circle around by simply banking to one side or another, you'll wind up approaching the runway from the side, or at an impossible angle. The best way to turn is to make an initial turn *away* from the direction you plan to turn.


Attempting to double back by simply banking right

In other words, if you want to turn to the right, first make a 45-90° turn to the left. Hold that for a few seconds, then turn to the right 270°.

Use the heading scale to guide you. If you have a heading of 09, turn left until the heading scale reads 36, wait a few seconds, then turn right until the heading scale reads 18.


Instead, try banking left, then right.

FLIGHT GRADUATION

You are supposed to "consult your notes" for procedures. For your convenience, we'll write up your "notes" here.

(Preliminary)

- A good habit to develop is checking your briefing map. It never hurts to check out what you're getting into, and the map almost always contains useful information.

(Checking the Map)

- In this mission you'll see you have six waypoints, then a landing approach.
- Make a mental note to yourself — after you finish the overland portion of the mission and head out over the water, descend to 1000ft or below and slow down to 500 knots or so. This gets you ready to land.

Takeoff

Full throttle.	Shift +=
Release wheel brakes.	B
Rotate at 180 knots.	Pull back on the stick
Raise gear.	G
Raise flaps.	F
(Climb to 5000ft.)	

Navigation

- Align solid line (command heading bug) with the ^ on the heading scale.
- Continue to follow through all waypoints.
- (Hit Autopilot (A) when you are satisfied with your heading.)

Landing

- (After the sixth waypoint, lower your altitude to around 1000ft. The runway comes up quickly.)
- Throttle back to reduce speed. -
- (200 knots is a good preliminary landing speed.)
- Enable ILS and line up to create a cross. L
- Lower gear. G
- Lower flaps. F
- (Use speed brake to bleed off speed.) S
- Apply brakes on touch down B

(Practice)

- **Taking off and landing.** These are two skills worth spending a little time learning, but don't hesitate to use the tutorial for getting to know your cockpit. This is a prime opportunity for seeing what an F-15 is capable of, and just having fun. (You are carrying weapons, you know — not that there's anything to hit.)
- **Loadouts.** Don't be shy — take advantage of the fact that, in these missions (as opposed to "real" missions) no one will be shooting at you. Your F-15's performance will alter with different loadouts, so you might want to play around with these. Hey — the more you know, the more you know.

- **Speed and altitude.** The F-15E Strike Eagle is notable for its ability to fly low, but it can also reach remarkably high altitudes. However, due to the difference in air density, the F-15 reacts differently at different altitudes.

  Get familiar with these differences. Pay attention to the airspeed indicator and altimeter as you put the plane through its paces. For instance, how high can you go? How steep a climb can you maintain? What causes enough negative G's to experience a "redout"?

- **Survival.** Practice the fine art of not hitting the ground. How high do you have to be to be able to pull out of a steep dive at 200 knots? 300 knots? Put your plane in a downward spiral, and practice using the HUD to show you which way is up. If you are headed straight down, is there a difference between pulling up out of it, and pushing the joystick forward, to come out upside down?

- **Maneuvers.** Try your hand at the maneuvers described in the manual, like the barrel roll and Immelmann. Get used to the way they look on your instruments, and the series of moves it takes to come out level. It's easier to learn when someone isn't shooting at you — press Shift A to jettison your ordnance so you'll be more agile.

  And don't forget to perfect the technique that will allow you to double-back and make another landing attempt — or more commonly useful, another bombing pass. (This is described in **Landing**, on p. 16.) The unfortunate truth is that you'll probably use this simple maneuver more often than the flashier Immelmann.

STRAFING

The goal of the mission is to strafe "soft" ground targets. A strafing run will always be against "soft" targets — such as unarmored trucks, parked aircraft and people. (But most often trucks and aircraft since people are a lot harder to hit.)

First, though, a word to the wise. There are three ways to look at this exercise:

1. **Don't do it.** The first and most realistic approach is to skip it entirely. The F-15E is not a strafer. Some missions may be strafing-based, but if you have a choice, you should avoid strafing when you can. The F-15Es just don't carry enough ammo. The training mission gives you unlimited ammunition, but if you don't have an infinite supply, you probably don't have enough to do much damage. (It is possible to adjust your game options to give you UNLIMITED AMMO.)

2. **Laugh at them all, fly for fun.** The second approach is to just fly around, having fun shooting the targets, and practicing your "circle back" maneuver. You may or may not hit them, and there's not much you can do to improve your odds beyond putting the reticle over the road and holding down the trigger. You can try flying low and slow, but that ends in a crash more often than not.

3. **Skip the baby stuff, fly this mission like a professional** — a professional with a few extra bombs at his disposal, that is. The third approach (and the most effective one) is to ignore your guns and drop all of your bombs on the runway. If you can totally obliterate the runway, the aircraft parked there don't stand a chance. Turn to **Unguided Munitions**, p. 24, for details.

Switch to Air-to-Ground master mode. *Press [M] 3 times*

- You can tell you're in Air-to-Ground (A/G) master mode by looking at the buttons below the UFC keypad, between the two MPDs. As you press [M], different buttons light up — you begin in NAV master mode, then cycle through INST and A/A before the A/G master mode button lights up. You can also simply click the A/G button to switch to A/G master mode.
- It's important to note that you can operate most buttons on the console while the game is paused. (You can't use key commands, and the A/G radar real-beam map will not update while you are paused, however.) If you can't get used to using the joystick with one hand and the mouse in the other, it's a good idea to pause. (Letting go of the joystick is generally a bad idea.)

Select the cannon. *Press [1]*

- When the gun is selected while you are in A/G master mode, a reticle (in this case, a circle with a dot in the center) appears on the HUD, indicating where bullets will hit. Your gun is fixed — it doesn't move to track its target. This means you have to steer the plane to bring the guns to bear on a target. With ground targets, this usually means your nose will be pointing at the ground.
- The mission starts with your plane perfectly aligned with the enemy runway. Gradually decrease your speed to around 500 knots, and descend to 300-500ft. Be careful not to pick up speed as you descend — press [S] to extend your speed brakes and lower your throttle ([-]) as needed.

Fire the cannon at the planes. *Press joystick button 1*

- Steer to place the gun reticle over.your target and fire. (Normally, you would have only 500 gun rounds, so it's a good idea to practice conserving ammunition.)
- And be careful! Don't forget that you are interested in your altitude *above ground level* (AGL). On the HUD, this number is preceded by an "R" and is located below the number in the box on the right side of the HUD. The number in the box is your *above sea level* (ASL) altitude. Relying on the ASL altitude will run you into the ground — the ground level here is about 90ft ASL.

UNGUIDED MUNITIONS

Dropping bombs is the F-15E Strike Eagle's primary function. Learn to love strike missions. They may not be as flashy as an air-to-air furball, but an accurate bombing run can do a lot more damage to the enemy's situation than taking down an enemy fighter or two.

This is a fairly straightforward mission. When it starts, you are at 2000ft and 700 knots. This is perfect. Speed is important — if you are flying too slowly, the reticle will be so low that you won't be able to see it on the HUD without nosing down. The same thing happens if you are flying too low. If you are flying too high, you can at least see the reticle, but the margin for error increases.

Maintain altitude.

- Stay level. Keep an eye on the velocity vector (-◇-), and make sure it stays near the 0° on the pitch ladder.

  Incidentally, the *velocity vector* indicates where your plane is heading, and the *waterline* (⌐w⌐) indicates where the nose of your plane is pointing. In most cases, the waterline will be a bit higher than the velocity vector. Sudden maneuvers may alter their positions, however. On a bombing run, released unguided weapons will travel in the direction your velocity vector indicates (due to the inertia).

Switch to Air-to-Ground master mode. *Press [M] 3 times*

- Double check that the yellow A/G button at the bottom of the console is lit. If it isn't, press [M] until the A/G button lights up. If you aren't in A/G master mode, you aren't going to be able to drop any bombs.

Select MK82 on the right MPD. *Left-click*

- The A/G Arm page automatically appears in the right MPD when you select A/G master mode. Click a pushbutton that has MK82 listed beneath it. You've now selected a Mk 82 station to release weapons. (If you click on both Mk 82 stations, weapons will be released from both. Note that you can't select two stations that have different weapons loaded on them.)

Line up the reticle on any of the buildings.

- In this case, you will fly directly over your target if you don't change course.
- The reticle should be near the bottom of your HUD, but still easily visible. If it starts to drift off the bottom, you are either losing speed or altitude. Keep your eye on your HUD, and try to maintain 2000ft and 500 knots.
- You may notice a thick arc moving around the perimeter of the reticle. This marks the range to your target and is explained on p. 2.21 of the *Expert Flight Manual*.

Drop bombs when the building is within the lower circular reticle. — Press joystick button 2

- The goal is fly level and steady, and to wait until the reticle is *centered* on the target to release the bomb.

Continue making passes and dropping bombs until the target is destroyed.

- You have 12 Mk 82s. You can drop multiple bombs at a time if you'd like. On the A/G Arm page, select the two Mk 82 stations and click PB 7 (RPL SGL) to release multiple weapons *one* at a time or PB 8 (RPL MPL) to release them *several* at a time. PBs 12 and 13 set how far apart (in feet on the ground) the weapons will impact, and PBs 3 and 4 controls the total quantity of weapons released. (These features of the A/G Arm page are discussed in detail on pp. 2.28-31 of the *Expert Flight Manual*.)
- When making multiple-weapon drops, you have to hold joystick button 2 down until the total quantity of weapons selected (using PBs 3 and 4) has been released.

(Practice flying loaded with bombs!)

This training mission affords you a valuable opportunity to practice flying while you are loaded with ordnance. After you feel confident dropping bombs, start over and just fly around fully loaded.

Practice banking and changing altitude. Notice what it takes to keep the plane level. (A loaded F-15E is simply incapable of performing most evasive maneuvers, and relies on any escorts or nearby aircraft flying Combat Air Patrols.)

GUIDED MUNITIONS

Contrary to what you might think, guided munitions are not essentially "better" than unguided munitions. They are better at some tasks, but then unguided munitions are better at other tasks. It's a matter of knowing what situation you are going into, and planning accordingly.

In general, choose a guided weapon (AGM-65, GBU-15 or Paveway) whenever it is important that a target be destroyed *without* destroying nearby objects. Such precision strikes should be handled with guided weapons whenever their use is feasible.

An example of an "unfeasible" situation might be a low-level delivery using Paveways. When using these laser-guided bombs, you have to "lase" the target just before the weapon impacts in order to ensure accuracy. To do this the laser must have an unbroken line-of-sight to the target just before impact. This often requires too high an altitude for a low-level delivery. You could use AGM-65Gs, but you are only capable of carrying two, which may not be enough to get the job done. (You can carry six D-models, however.) In this situation, careful and accurate targeting using Mk 82 AIRs in Auto bombing mode might be the better option.

A word to the wise, though — guided munitions are much more expensive and usually scarcer than their unguided counterparts. If you're flying a campaign, you have to conserve your assets — only use guided weapons when it is truly necessary.

Switch to Air-to-Ground master mode. *Press [M] 3 times*

- In a real mission, you'd need to switch to A/G master mode in order to find and pinpoint your target, which could take some time. Remember, *you* are the target on the ingress and egress — while you are looking for your target, it's a good idea to keep the TEWS page up in the right MPD in place of the A/G Arm page, which appears automatically. You can then switch back to the A/G Arm page to select weapons stations once you've found your target.
- To pull up the TEWS page, click PB 11 (M), then PB 13 (TEWS). To pull the A/G Arm page back up, press PB 11 (M), then PB 13 (A/G ARM). Note that you will have to switch to A/A master mode before you can fire air-to-air weapons.

Click on the AGM-65 on the right MPD. *Left-click*

- This mission focuses on the AGM-65 Maverick. It is the only air-to-ground missile you have access to in this game. All of the other weapons lack propulsion units capable of propelling them all the way to target, and are therefore called bombs. Bombs fall ballistically, "powered" only by gravity and the inertia due to their forward velocity (equal to your plane's) at the time of release. (Some bombs may have small propulsion units to drive the weapon below the surface of the ground, however.)

Select the target in the HUD by clicking on it with the mouse. *Left-click*

- A target designator (TD) diamond appears over the target. If it looks off-center, just click again. Every time you click on the HUD, you re-designate the target. (Once you've launched the missile, however, it can't "sense" the new target designation — it will continue to head for the old target.)

Fire the weapon *Press joystick button 2*

- By default, the Maverick will automatically try to gain a lock on the target as soon as it is designated. (You can actually change this, but it just makes things harder.) The more you can do to line up before release, the better — head directly for the target when possible, and fly level and steady when you don't have to avoid incoming fire. However, these missiles are fire-and-forget — *after* you've released them, get ,out of Dodge.

Continue to make passes and dropping munitions until the target is destroyed.

- Although you can only carry 2 AGM-65Gs or 6 AGM-65Ds at a time, you still have 12 Mk 82s in the default loadout.

(Load some GBU-15s and GBU-10s and try this one again.)

Although AGM-65s, GBU-15s and Paveways (GBU-10s, -12s, -24s, and -28s) are all guided weapons, they have different guidance systems, so the procedures for releasing them differ. The *Expert Flight Manual* gives instructions for dropping these weapons on pp. 4.66-96. You can use this mission to practice them — a ground target is already set up and there is no enemy opposition.

A/G GRADUATION

Once again, you should refer to your notes, or to the notes below.

Using Cannon (Strafing)

Switch to Air-to-Ground master mode.	M x 3
Select the cannon.	1
Fire the cannon.	Joystick button 1

Using Unguided Munitions

Level delivery at 500 knots and 2000ft.	
Switch to Air-to-Ground master mode.	M x 3
Select Mk 82 on MPD.	
Line up on the target and drop bombs.	Joystick button 2

Using Guided Munitions

Switch to Air-to-Ground master mode.	M x 3
Select AGM-65 on MPD.	
Click in the HUD to select the target.	
Fire the weapon.	Joystick button 2

(Checking the Map)

- This is not the most informative mission map ever created, but it does show you the basics. You will head to the island, and then essentially skirt the shore.

(Checking Your Ordnance)

- You shouldn't wait until you are in the air to know what's on your aircraft. Open the ARMING screen from the mission briefing, and you'll discover that you've got two AGM-65s, and 12 Mk 82s. That's a good thing to keep in mind when you are deciding which weapon to use.

(Making Your Approach)

- Everything on the island is fair game. Remember, both speed and height are important. If at any point you aren't going fast enough, bump up your engine thrust, or hit your afterburners.
- If you look at your map, you'll notice that your current steerpoint doesn't have any buildings on it. Off to your left, however, there is a complex that is sitting out in the open, ready to be bombed by your best shot. There's no reason not to adjust your course and head directly over to it, at the appropriate altitude and speed, no banking required.

(Releasing Weapons)

- When you are preparing to drop a weapon on something that looks flammable, you need to be pretty high, or you're going to get burned. There are oil tanks and wells on that island. 2000ft up is a good height; 200 feet up is dangerous.
- You'll notice your WSO compliments your bomb release when you are level and steady. That's the goal you're shooting for.
- Once you've dropped a bomb on an area, that area will remain on your designated target, in case you'll have to make another pass. If you want to designate another target, left-click on it in the HUD or radar MPD.

(Doubling Back)

This is a small island, and you can't just fly in a circle, dropping bombs. Instead, you'll have to fly out, turn around, and make another pass. Don't hesitate to fly far out, so that you can make your next approach at the correct speed and altitude. Remember that turning bleeds off speed, so you really need to go out a distance and build up the correct speed on your way back in.

Keeping an eye on the A/G Radar MPD (left side) is helpful in orienting yourself. When the waypoint (and target triangle) comes back in front, it's time to level out.

A/A GUNS

Air-to-air combat is arguably the most dangerous part of a mission, for the obvious reason that someone is actively and persistently trying to kill you. What makes it twice as bad is that as an F-15 pilot, you're usually carrying a heavy bomb load, which weighs your plane down and makes it less maneuverable.

It's important to remember that if you've got bombs loaded you're a sitting duck for any interceptor who gets close enough to put you in his gunsights. Don't let him get anywhere near that close.

One more time, for emphasis. *If you are carrying bombs, you can't maneuver.*

Air-to-air combat can either be *beyond visual range* (BVR), meaning you fire radar-guided, medium-range missiles at blips on the radar screen, or *close*, meaning you maneuver to fire short-range missiles at an enemy staring you in the face. If you're loaded for a strike mission, try for the BVR variety. Watch the TEWS page to see if anyone picks you up on radar. If you are picked up, the best thing to do is *not* to select your gun, but to press [Shift][Tab], then [3] to call for air support (which may or may not be available). Meanwhile, find the aircraft that is targeting you and fire off the longest-range missile you have.

(Jettison your air-to-ground ordnance.) — *Press* [Shift][B]

- This will make it easier for you to maneuver.

Switch to Air-to-Air master mode. — *Press* [M] *twice*

- At this point you can choose to fire either missiles or guns.
- That speck in the distance directly ahead of you is the enemy aircraft. It is heading directly toward you at a higher altitude.

Select cannon. — *Press* [1]

- This will place a "funnel" on the HUD.
- The funnel is a targeting device designed with an average-sized fighter aircraft (40ft wingspan) in mind. The goal is to position the enemy aircraft so it is inside the funnel, with each wingtip just touching the funnel lines. This will help ensure your bullets hit their target.

Acquire the target. *Press [5]*

- Pressing [5] activates Supersearch auto-acquisition mode and momentarily places a large circle on the HUD, indicating the area scanned for targets. The second a target is acquired, the radar will begin to track it (all other contacts will disappear from the MPD) and a target designator (TD) box appears over the target on the HUD.
- Acquiring the target allows you to track it if you do not destroy it on the first pass. The TD box will move to the edge of the HUD when the aircraft moves off the HUD or out of sight. Steer toward the TD box to bring the target back into gun range. (Note that if your target flies too far to your left or right (60° from your nose to be exact) he will break your radar lock.)

Line up funnel on target.

- This is the tricky part — it takes a steady, practiced hand to get a solid fix on a moving object. The practice is definitely worth the time invested, though.
- "Whipping it" (i.e., thrashing wildly) is less effective than a stable funnel.

Fire cannon when lined up. *Press Joystick button 1*

- The plane is coming straight at you. You don't have to rush, but if you miss him, you'll have to turn around and try again. Don't worry about being fired on — he won't attack you in any way.

(Practice missing the ground.)

- You're in the mountains, where the ground is well above sea level. Don't look at the altitude number in the box (which is altitude above sea level), look at the number below it (altitude above ground level). Try your hand at flying in the valleys. This is one of the best ways to avoid radar.

(Practice with different loadouts.)

- Try the exercise with a variety of different loadouts. In particular, try it with no weapons loaded and then with a full loadout to get used to the weight and drag difference. Practice flying in the valleys with these loadouts, too.

SIDEWINDER

(AIM-9M, in this case)

In this tutorial, the Sidewinder appears almost magical in its ability to shoot down an aircraft. In a real mission, your enemy will probably try to drop flares or fly "into the sun," to fool the missile into veering away. This tutorial does not simulate combat conditions at all, but provides a nice, calm atmosphere in which you can learn the basics.

The best thing that you can get out of this tutorial is an idea of the effective distance of a short-range missile. First of all, any missile will accelerate for about 3000 feet before it begins to maneuver. 3,000 feet is a little over half a mile — essentially 10 football fields. If you fire a missile at something closer than that, the missile won't swerve to hit the target — it will only impact the target if you're lucky enough for the target to be in the missile's straight flight path. Even then, it may not have armed, so the impact could be less than dramatic.

In these training sessions, take some time to get a feel for max and min missile ranges. Practice "getting an eye" for how far away your enemy is.

Switch to Air-to-Air master mode. — *Press [M] twice*

- Any time you think there might be enemy aircraft in the vicinity, switch to A/A master mode, unless you have something more urgent to do. (There are, however, few things more important than an enemy aircraft nearby.)

Select SRM (SRM = Short-Range Missile). — *Press [2]*

- Pressing [2] puts your avionics into short-range missile (SRM) launch mode. SRM appears in the lower left corner of the HUD when you are in this mode.
- Note that you cannot directly choose what type of SRM will fire when you press joystick button 2. Once you select SRM missile launch mode, the computer will automatically cycle through all of your SRMs (which in this game are AIM-9s) in a set sequence.

- You can "reject" or "step over" any missile in the sequence by pressing [4]. You would probably only do this if you had two different types of AIM-9 loaded and you wanted to fire a specific one. In this mission, you've only got AIM-9Ms.

Acquire the target, SS AUTO ACQ — *Press* [5]

- This is the same auto-acquisition mode described under **A/A Guns**, p. 30.
- Shortly after the TD box appears over the target, a circle will appear inside the box. This means that the missile seeker head is attempting to track the target. Press [U] to uncage the missile seeker head. A lock-on tone indicates that the missile is tracking a target. When released, the missile will head for that target by homing in on its heat signature.

Launch missile when you see a flashing triangle under the target box. — *Press joystick button 2*

- The flashing triangle is called a *shoot cue*. It essentially tells you that the missile has a lock, and that the target is in range.
- This is a good time to mention range. You don't have to really worry about what range to fire at — the shoot cue tells you this. And if you come too close to the target a large "X" appears in the center of the HUD, telling you that the missile can't hit the target.

  But if the target is outside the missile's maximum range, how do you know how far outside the range it is? On the right side of the HUD is a radar range scale. The entire length of the scale is equal to the radar's current range. A bracket on the right side scale marks the weapon's effective range. A caret on the left side of the scale marks your target's current range. The number beside the caret tells you how fast the distance between you and the target is increasing or decreasing — if this is a large, positive number then the target is moving toward effective weapon range.

(Practice launching Sidewinders without using the radar.)

- Because the Sidewinder is a heat-seeker, it is possible to gain a missile lock on the target without using your radar at all. This can be a deadly trick, as your target's radar warning receiver will not sense your radar switching from search to target mode and therefore can't warn the pilot that he is being locked up. See **Firing an AIM-9** on pp. 4.31-41 of the *Expert Flight Manual*.

AMRAAM

(Otherwise known as the AIM-120)

If you know how to launch a Sidewinder, you know most of what you need to know to fire an AMRAAM.

As you might guess, the short-range Sidewinder is used when the enemy is closer, and the medium-range AMRAAM when the enemy is farther away. Essentially, if the enemy is close enough to see, use a short-range missile. If he's just a blip on your radar MPD, use the medium-range missile.

Switch to Air-to-Air master mode. — Press [M] twice

- If you aren't in Air-to-Air master mode, you aren't going to be able to launch an air-to-air missile. But you knew that.
- Look at the A/A Radar MPD on the left. The rectangle with a 1 beside it is the enemy. At this point, he's already fairly close.

Select MRM (Medium-Range Missile). — Press [3]

- When MRM launch mode is selected, MRM appears in the lower left of the HUD.
- Just because you are in MRM launch mode, doesn't mean an AIM-120 is the selected weapon. The F-15 can carry two types of MRM — the AIM-7 and the AIM-120. When you choose MRM launch mode, the aircraft will cycle through *all* of your MRM weapons automatically.

  However, the cycle begins with the AIM-120s you have on board, as these have a longer range. (And in this mission, you don't have any AIM-7s loaded.)

Click on the square dot in the left MPD. — Left-click

- As soon as you select a target, the MPD changes in appearance. The target is centered on the radar screen, and its symbol changes from a rectangle to a star at the end of a long stick. This means the aircraft is now your primary designated target.
- So, you might be thinking — why didn't we just press [5] and use Supersearch auto-acquisition mode to acquire the target as we did in previous missions?

Auto-acquisition modes tell the radar to focus on a small portion of its scan area and lock onto the closest target it finds there. Supersearch was designed to search a very wide area, but at close range — out to only 10nm. At the beginning of this mission your target is further away than 10nm.

- You can always click on any blip on the radar screen to make it your target. This is your best bet with long-range targets (i.e., dots on the horizon).

At closer ranges you can use auto-acquisition modes:

- *Supersearch* (5) selects the nearest close-range target (<10nm) in a wide area in front of you. Use this when any target will do.
- *Boresight* (6) selects a target at the same range, but focuses on a small area just around the waterline on the HUD. Use this to single out a particular target — steer so that it is nearest the waterline and press 6.
- *Long-range boresight* (7) focuses on the same small area as Boresight, but has a range of 40nm.
- *Vertical scan* (8) is the mode to use when dogfighting. It searches for targets in a vertical band extending up from the nose of your aircraft, out to 10nm. If you are tailing a bandit, this is where he should be.

Launch missile when you see a flashing star under the target box. — *Press Joystick button 2*

- In this tutorial, that's pretty much as soon as you lock on the target.

(Practice, practice, practice.)

If you feel up to it, get some practice with multiple targets.

1. Go into the Single Missions. Select LOAD, then BINTRCPT.
   This is a combat situation with a lot of enemies in a small area. There is one problem you'll need to fix — the default loadout only gives you two AIM-120s.
2. Select ARMING, then CUSTOM. Drag an AIM-120 onto any hardpoint that will accept it. (The cursor will turn into an arrow over the appropriate spaces.) When you are done, there should be eight AMRAAMs loaded.
3. Click the SAVE button — name this loadout ALL120S.
4. Select ACCEPT, ACCEPT and then FLY.

A/A GRADUATION

Here are some notes, should you feel the need to refer to them.

Using Cannon: Gun

Switch to Air-to-Air master mode.	[M] x 2
Select cannon.	[1]
Acquire the target.	[5]
Line up funnel on target.	
Fire cannon.	Joystick button 1

Using Sidewinder: AIM-9M

Switch to Air-to-Air master mode.	[M] x 2
Select SRM launch mode.	[2]
Acquire the target.	[5]
Launch the missile.	Joystick button 2

Using AMRAAM: AIM-120

Switch to Air-to-Air master mode.	[M] x 2
Select MRM launch mode.	[3]
Acquire the target.	Left-click on radar blip
Launch the missile.	Joystick button 2

(Checking the Mission Map)

- You first face a Tu-22M at 22,000ft.
- You then face one or more Mi-24s at 1000ft.
- You then face a MiG-21 at 10,000ft.
- Armed with this knowledge, you can do some preliminary planning:
  - Helicopters (Mi-24s) don't put out much heat, so the heat-seeking Sidewinders won't work well against them.
  - MiG-21s are both hard to hit and extremely dangerous. They are capable of carrying both long- and short-range missiles.
  - The Tu-22M has a tail gun, but no missiles. If you can stay in front of it, it's a sitting duck.

Your initial plan might be to save your AMRAAMs for the MiG-21, use your Sidewinders on the Tu-22M, and go for the Mi-24s with guns.

(Making the First Pass Count)

- The Tu-22 is above you, and that puts your missiles at a disadvantage (they have to overcome gravity). Crank your throttle to 100% thrust and climb. While you are climbing, switch to SRM launch mode and attempt to get a lock. You can expect this pilot to try to maneuver away from incoming missiles, so when you get a lock, fire off two in short succession.
- As soon as the Tu-22M is down, go immediately to the next waypoint. You can either practice your flying and banking, or you can press Shift J to jump to the next action point.
- The Mi-24s are going to be a pain. Helicopters are really maneuverable, and it can be hard to get a bead on them. Remember that you can climb higher than they can, and a higher altitude would put their guns and missiles (if they were using them) at a disadvantage.
- **Note:** *If this were a real mission and the Mi-24s weren't your assigned target, your best bet would be to simply outrun them.*
- Since you know the MiG is there, get a lock on him as soon as you can and fire.

TEWS — SAM & AAA

TEWS stands for Tactical Electronic Warfare System. This system detects air and ground threats that are *actively* using radar. Primarily, these threats are aircraft and anti-aircraft sites. Note that aircraft and ground-based threats that do not have a radar or simply have their radar switched off will *not* (repeat, will *not*) show up on the TEWS.

Bottom line, the TEWS doesn't tell you everything. But what it does tell you can save your life. Rely on it heavily, but know its limitations.

Switch to ATA (Air-to-Air) master mode. *Press* [M] *twice*

- In this scenario, there are no planes in the vicinity. Your only goal for the mission is to see the ground threats on the TEWS and make them disappear.
- You can, and should, use the TEWS in any master mode. Simply press PB 11 on any MPD to go to the main menu, then press PB 13 (TEWS) to select the TEWS page. In A/G master mode, try to keep the TEWS page up in the left MPD as much as you can.

The TEWS will be displayed on the right MPD.

- You've seen this before in all the previous air-to-air tutorials, but there haven't been any ground threats to appear in it.

You will see different symbols being displayed on the page.

- The first thing you will see is a "10" in a square box. This is a SAM site, an SA-10 site, to be precise.
- Dive to the left of the mountain ridge. Notice how the SA-10 disappears from the TEWS display.

Code	Ground Emitter	Radar System
EW	GCI	Barlock/Flat Face
2	SA-2	Fan Song
3	SA-3	Low Blow
6	SA-6	Straight Flush
10	SA-10	Flap Lid

You have broken its radar lock. If it hasn't launched, it won't be able to until it can get a lock. If it has launched, you've made it hard or impossible for the missile (which receives command guidance from the site that launched it) to hit you.

TEWS — AIRCRAFT

The point of this tutorial is to learn what a TEWS looks like when a bandit is approaching, and practice using countermeasures. As in the case of a SAM site, a coded symbol marks the aircraft on your TEWS screen in the approximate o'clock location where you will find the enemy aircraft.

Switch to A/A master mode. *Press [M] twice*

- Again, you can use the TEWS in any master mode. However, you can only fire air-to-air weapons in A/A master mode.

The TEWS will be displayed on the right MPD.

- As soon as the TEWS determines what the bogey is, its code number — in this case a 27, for Su-27 — appears next to its symbol.

Code	Aircraft Emitter	Radar System
27	Su-27	Slot Back

- A symbol's position on the TEWs display tells you its o'clock position with reference to your aircraft and the strength of the radar source. Your aircraft is in the center, with its nose pointing toward the top. To bring this aircraft in front of you, steer so that its symbol is at the top of the display.

  The closer the symbol is to the center of the display, the stronger the radar signal. This doesn't necessarily have anything to do with how close the emitter is to you physically. Some radar systems — such as early warning radar systems, for example — have much stronger signals than the average fighter.

(Drop countermeasures and fire weapons.)

- This bandit is out to kill you. In fact, he'll probably launch missiles at you before you can a lock on him. When your WSO yells at you to drop flares, hit [Ins] and get out of the way. You want the missile to head for the hotter flares — if you're between the missile and the flares, the odds that it will be distracted are smaller. Lay off the afterburners — they'll attract IR missiles.
- You can be pretty sure the target is in SRM range, because the WSO yelled for flares, which are anti-IR countermeasures. If the threat had launched a radar-guided weapon, the WSO would yell for chaff and you would want to press [Del].

INFLIGHT REFUELING

Inflight refueling is hard. It's hard in real life, and it's hard in *Jane's F-15*. Don't expect to accomplish anything the first time you try your hand at it.

The idea behind inflight refueling is that on long missions the F-15s need to refill their fuel tanks, and they don't have the time or the friendly territory to touch down and do it the old fashioned way. Instead, a large, well escorted tanker aircraft flies to the refueling area, where it circles until the F-15s arrive.

The tanker then flies in a straight line and lowers a boom. The F-15E has a slot in the upper part of the fuselage that this boom will slide into (assuming all works according to plan ...). Once connected, the two aircraft fly at identical velocities while fuel is transferred. When the F-15E is full, the tanker retracts the hose and the process is complete.

As you might have guessed, the tricky part is lining up correctly with the tanker, so that the fueling process can begin.

Note: *There's always an easy way out. You can refuel automatically at any time by pressing* Alt F. *Your aircraft will autopilot to the nearest tanker, hook up, refuel and then unhook.*

Bring up radio communications channel 2. *Press* Shift Tab

- This channel lets you talk to AWACs or JSTARs aircraft and airfields. When you press Shift Tab, a menu appears in the upper left corner of the screen.

Select Tanker. *Press* 5

- You'll notice that each menu option is preceded by a number. Press that number on the keyboard to select the option. In this case, the option you are looking for is (AWACS) REQUEST NEAREST TANKER.
- Basically, you are radioing the AWACS in you area to send you the coordinates of the nearest tanker. If no tanker were available, he would say "Negative. No assets Available." If a tanker is available, the AWACS will send you coordinates, and radio the tanker to begin a refueling pattern.
- In this mission, time is of the essence. It will be difficult to sync up if you lose sight of the tanker, so make the radio call as soon as you begin.

The tanker will now start a pattern.

- **Big Hint:** Before you try to complete a refueling scenario yourself, go through Auto Refuel (Alt F) at least two or three times to get a feel for the process:
  - The first time, notice how everything looks — the position of the tanker, the distance of the hose from your HUD, etc.
  - The next few times, keep an eye on your instruments and notice the heading, altitude and airspeed readings as the approach is made.

Steer to the heading that the tanker calls out.

- Memorize this heading, for you won't hear it again.

  If things get messed up, you'll need to radio (AWACS) REQUEST NEAREST TANKER again, which will also signal the tanker to begin another pattern. Thus, the heading you receive will be slightly different each time you radio.

Start your approach to the tanker slightly above his altitude (20,000ft).

- A slightly higher altitude is best, but a successful refueling can be done without this step.

At half of a mile from the tanker drop about 50 feet below and move forward into contact position.

- This does not happen quickly, so don't expect it to. Slowly move into position, and be ready to make any small adjustments as necessary.

(Once in contact position listen to the cues given to you by your WSO.)

- Even when your WSO tells you to do something, the key is not to make any sudden moves. Slow and easy, and no one will get hurt.
- A properly adjusted joystick can make a world of difference when you're trying to refuel.

WINGMAN GROUND TARGETS

Often there are far too many targets for one aircraft to destroy — as a good rule of thumb, expect each plane to destroy one target per waypoint (steer point).

(Before you take off, check the target assignments.)

- For strike missions, each F-15 in your flight should have ground target assignments before takeoff. Check this in the briefing stage prior to a mission, after you've looked at the map. From the *Briefing* screen, click TARGETING. See **Targeting/Assign Targets** on p. 1.15 of the *Expert Flight Manual*.

Bring up radio communications channel 1. *Press* [Tab]

- This menu lets you choose which aircraft in your flight to radio.

Select "Wingman" *Press* [1]

- Pressing [1] brings up a menu of wingman commands.

Now select "Ground Attack." *Press* [8]

- Selecting option 8 (GROUND ATTACK) brings up a submenu of attack commands.

Select "Attack Primary Target." *Press* [1]

- The primary target is the mission's main goal objective. In this tutorial, there are no secondary targets. There are no other targets at all, in fact. However, if there were, option 2 (ATTACK SECONDARY TARGETS) would send him after secondary objectives, and option 3 (ATTACK GROUND TARGETS OF OPPORTUNITY) would send him after anything he could find.
- You can issue the "Attack Primary Target" command to your flight with [Ctrl][G].

Your wingman will now commence an attack on the building and make multiple passes until the target is destroyed.

WINGMAN AIR TARGETS

This is essentially the same as a ground attack, but in reality it is much more vital to your continued well being.

Bring up radio communications channel 1. **Press** Tab

Select "Wingman." **Press** 1

Now select "Engage Bandits." **Press** 1

Your wingman will now commence attacking the inbound bandit.

- Once the bandit is destroyed, you'll notice another aircraft in the vicinity. That's your wingman, and you'll *really* want to learn how to tell him apart from other planes. He gets annoyed if you shoot him down.
- This is also a good time to practice. Try giving your wingman some of the other available commands, and see how he reacts.

(Practice commanding a larger flight.)

- You can issue the "Engage Bandit" command to your flight by pressing Ctrl E.

You've probably noticed that aside from WINGMAN, there are three other options available when you press t to call up the radio channel 1 menu: DIVISION, ELEMENT and FLIGHT. An F-15 ***flight*** can consist of two to eight aircraft. ***Divisions*** and ***elements*** are subsets of a flight. You will always be flight leader, meaning all aircraft in the flight take commands from you.

On some missions you will direct a flight of more than two aircraft. You might want to read the **Managing Your Flight** section on pp. 4.43-50 of the *Expert Flight Manual* first. It talks about the structure of a flight and different commands. To practice using these commands, create an Instant Action mission, setting the NUMBER OF WINGMEN to 7 and the NUMBER OF ENEMY AIRCRAFT to 8. Set ENEMY PLACEMENT to "disadvantage," and pick an A/G TARGET for your flight. Practice giving different parts of your flight different tasks to learn what computer-controlled aircraft do best. Later, think about arming the aircraft differently to "specialize" them for escort or strike roles.

MISSION TYPES

OVERVIEW

Because of the F-15's ability to adapt to different roles, the missions assigned to it vary. This is true in real life and in this simulation.

This chapter describes the most common mission types you'll run across in *F-15*. For each type, you'll find a general description of the goals and conditions to expect for this type of mission, **Playtester Tips** for successfully completing one, and a fly-through of an **Example** Single mission that best illustrates that mission type.

Note: *You might want to fly these missions with* INVULNERABLE *and* NO CRASHES *options active. This will keep you alive long enough to learn how to play the game.*

Index of Mission Types

Below is a list of the mission types described in this chapter, along with the name of the single mission used to illustrate each type, the purpose of that mission and the page number at which the section begins.

Single Mission Thumbnails

Not all of the Single Missions in the game have been used as examples in this chapter. However, you might want to fly some of the ones we don't detail here in order to practice the skills you learn in the ones we do describe.

Below is a list of all single missions, with the **Full Name** for each mission, the **Short** name as it appears in the *Load Mission* screen, which **Type** of mission it is and what the specific **Goal** of the mission is. The **Time/Vis**ibility column will give you an idea of the flight conditions you are facing.

Note: *Missions between 1800 and 0600 (roughly) are night missions — adjust your systems and weapons loadout accordingly.*

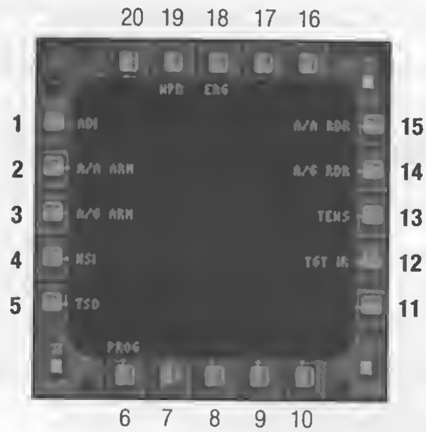
Full Name	Short	Type	Goal	Time/Vis
Airfield Attack	ARFLDATK	Airfield Strike	Destroy runway	1800/Clear
Fighter-Bomber Interception	BINTRCPT	Air Intercept	Intercept Tu-22 Blinders	1400/Clear
Chemical Attack — Iran	CHEMIRAN	Std. Bombing	Destroy chem warfare site	0115/Clear
Chemical Attack — Iraq	CHEMIRAO	Std. Bombing	Destroy chem warfare site	1955/Pt. Cloudy
Fire-Storm	FIRESTORM	Air Intercept	Air battle at night	2340/Clear
Hostage Rescue	HIJACKED	Airfield strike	Destroy runway/ground C-130	1030/Pt. Cloudy
TACAIR	IRAOPUSH	CAS/SEAD	Hit ground forces in battle prep.	1430/Clear
Khark Island Attack	KHARKBOMB	Std. Bombing	Strike fuel tanks/avoid air cover	1300/Clear
Factory Attack	MNTNBOMB	Std. Bombing	Destroy factory/avoid SAM/AAA	1300/Clear
Oily Vengeance	OILYVENG	Std. Bombing	Oil reserve attack for OPEC	1030/Clear
Pirate Hunt	OSAHUNT	Anti-Ship	Destroy OSA patrol ship base	0340/Clear
Rolling Thunder	RLGTHNDR	Airfield Strike	Strike enemy airfield	1030/Clear
Just Routine	ROUTINE	CAP	CAP through Strait of Hormuz	0900/Clear
Tanker Practice	TANKING	n/a	Midair refueling practice	1200/Clear
Terror for the Terrorists	TERRORIS	Std. Bombing	Destroy terrorist base	2005/Clear

QUICK REFERENCE

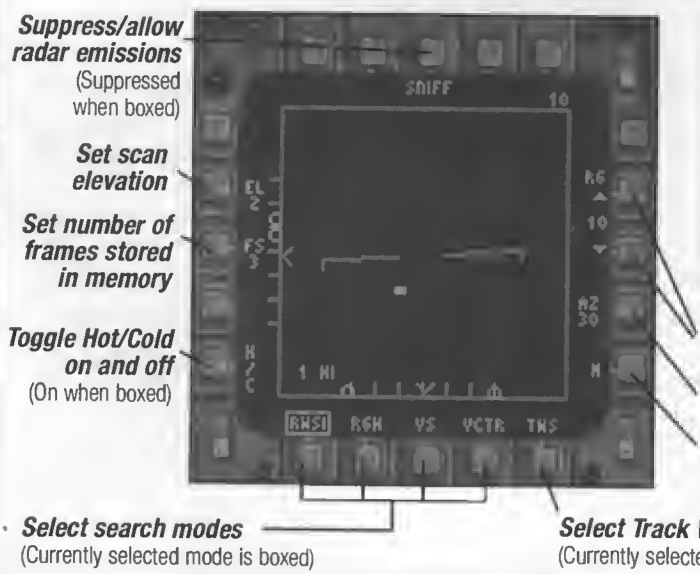
We've repeated some information from the *Expert Flight Manual* that you might want to keep in front of you as you fly.

MPD and UFC Pushbuttons

We've used the same numbering scheme as the *Expert Flight Manual:*



A/A Radar Icons and Pushbuttons



A/G Radar Icons and Pushbuttons

Cursor azimuth (where the radar cursor position is in relation to your aircraft)

Cursor range (how far away (in nm) the cursor position is from your aircraft)

Suppress/allow radar emissions (Suppressed when boxed)

Freeze radar screen (Radar does not emit when frozen. Frozen when boxed.)

Increase/decrease radar range

Change search mode

Set cursor function (map or target)

Set HRM size

Set azimuth scan angle

Steer point

Base

Target point (currently designated A/G target)

Initial point (steer point prior to target point)

Ground Moving Target (indicate areas of movement; only appear in GMT or IGMT modes)

TEWS Icons and ID Codes

Ground emitter

Aircraft emitter

Missile emitter

Icons with circles around them indicate a threat that has a lock on you.

Flashing icons indicate a threat passing commands to a missile.

Aircraft Codes	
14	F-14
15	F-15
16	F-16
18	F/A-18
21	MiG-21
22	Su-22
23	MiG-23
24	Su-24
25	MiG-25
27	Su-27
29	MiG-29

Aircraft Codes	
31	Su-30
35	MiG-35/Su-35
40	F-111
41	Tornado
42	Tu-22
43	B-52
EW	AWACS
F1	F1 Mirage
F4	F-4E
F5	F-5E

Ground Codes	
EW	GCI
2	SA-2
3	SA-3
6	SA-6
8	SA-8
10	SA-10
11	SA-11
SD	SA-11
13	SA-13
23	ZSU-23-4
RO	Roland
HA	Hawk
S	OSA Boat
AA	AAA

COMBAT AIR PATROL

Part of establishing superiority on the ground is making sure the skies belong to you as well. Regardless of the lineup on the ground, whichever country maintains air superiority over an area — meaning they are unopposed as they fly through it — usually controls what happens below.

To maintain air superiority, most militaries opt to keep a nearly continuous fighter presence in areas where trouble might occur. The ultimate purpose of a Combat Air Patrol (CAP) mission is to make a show of force to the enemy. The secondary purpose, though just as important, is to detect trouble and immediately address it if necessary. Pilots are sometimes restricted in the use of weapons and aren't allowed to fire on enemy aircraft unless they're fired upon first.

Most of the time, CAPs are flown near military boundaries or through no-fly zones. CAP flights usually involve two aircraft — one operating as the flight leader, and the other as his wingman. The wingman supports and protects the flight leader. The leader is the decision-maker and orders any offensive attack. If anything goes wrong, responsibility falls upon the shoulders of the lead pilot.

The battle for air supremacy is on-going, and CAPs are sometimes flown in constant succession. During Desert Storm, for example, when one CAP flight returned to Al Kharj, another one departed. In this manner, American forces were able to establish and maintain air superiority over the skies of Iraq.

CAP missions typically involve air-to-air engagements, and the fighters are armed accordingly. Some pilots may say they prefer to carry along at least a couple of air-to-ground missiles or bombs in case important ground targets are discovered while they're in the vicinity, but that is like bringing a knife to a gunfight. These weapons add weight, and you'll be less maneuverable right when you need the extra turning power.

Combat air patrols generally fall into one of four categories:

- *BARCAPs* are barrier CAP patrols that take place along the edge of the battle area and are defensive in nature. The idea is to make sure no unauthorized aircraft cross over into friendly territory.
- On the more aggressive side, pilots in a *MIGCAP* mission spend their patrol time hunting down enemy aircraft, attacking MiGs in particular.
- In a *Target CAP* (or TARCAP), a flight flies over a specific target area to ensure air superiority. These missions are designed to protect a target point — e.g., a bridge that friendly ground forces are about to take.
- Finally, in a *Search-And-Rescue* (or SARCAP) mission, fighters sweep the airspace around a downed aircraft. Their job is to protect the crew until rescue helicopters can arrive.

In *F-15*, you'll perform the CAP missions described above, plus a few variations on the theme. For instance, in one of the campaign missions, you are tasked with finding and protecting a search-and-rescue aircraft as it completes an extraction mission. Some missions will give weapons-free status, meaning that you can freely release weapons. Others will put you on weapons-hold status, meaning you can't fire first. Due to the fact that you're often covering a lot of ground in a CAP, these missions take longer than normal to complete. (You'll probably find the JUMP feature useful in these cases.) You may even occasionally have to refuel in mid-air.

Playtester Tips

- If you aren't looking for anything specific on the ground, fly with the A/A master mode active on the way to the target. If any trouble arises, you'll be ready to pop off a few A/A missiles.
- Casual TEWS mode makes threat detection and identification a lot easier — enemies are red and friendlies are gray. You can switch modes in the Options screen. (Go to the GAMEPLAY submenu, then select CUSTOM. Under TEWS, click the circle next to CASUAL until a dot appears in it.)
- As an added bonus, Casual TEWS mode automatically gives you the direction and heading for any enemy plane within 40 kilometers.
- If you're flying with REALISTIC TEWS active, you'll have to rely on the ID codes to determine whether a bogey is friendly or enemy. (All aircraft are represented by an upside down V. Beneath the V is an alphanumeric code which tells you what the aircraft is. A list of these codes appears on p. 49.)
- All aircraft show up as boxes on the A/A Radar MPD. As soon as you detect an aircraft, target it by left-clicking on it in the A/A Radar MPD. The blip on the radar will turn into an asterisk with a line. The line extends out from the asterisk and indicates the target's heading.

- Once you've targeted something, everything else disappears off of the A/A Radar MPD. Press Bksp to restore all icons onto the A/A Radar MPD. Or press PB 10 on the A/A Radar page to select TWS mode — this keeps the target designated, but puts nearby A/A contacts back on the screen.
- If you're playing in Casual flight mode, you don't have to send out an IFF query to determine if the aircraft you've targeted is friendly. The targeted aircraft icon will automatically flash between an asterisk and a circle if it's friendly. If you're playing in REALISTIC mode, set IFF to AUTO (PB 3 of the UFC cycles through options) to have the computer send IFF queries automatically; or set IFF to NORM, and press I to send a squawk to your target.
- If you anticipate trouble, go ahead and press 3 to get into MRM launch mode. This saves time later.

- Make sure your target is in range before you fire! Many missiles are wasted by the simple fact that the pilot fired too early.

  Watch the range scale on the right side of the HUD. A missile's maximum range will vary according to altitude, and this is factored in when the targeting computer places range indicators on the scale.

  Wait until the caret is inside the brackets before firing. A shoot cue will also appear under the target designator (TD) box when the target is within weapon range.

- To make detecting your target easier, narrow the radar's horizontal scan, but increase it's vertical scan. By flying in a circle, you can paint a larger picture of the immediate area and catch things you might miss with a wider, shorter scan.
  - Press PB 13 of the A/A Radar MPD to increase your radar range to 80km.
  - Press PB 12 to set the azimuth scan angle to 15° (default is 30°).
  - Press PB 2 to set scan elevation to 6 (the default is 2).

- Most CAP briefings recommend flying fast and low. This helps you avoid being detected by the enemy, since SAMs have a harder time seeing low targets. However, if you do fly low, remember to check above occasionally for enemy aircraft.

- If you're having trouble finding specific mission targets in a Single mission, try opening the mission up in the Mission Builder. Look for objects with flags. Green flags mark mission objectives — enemies that must be destroyed or friendlies that must be protected in order for you to win the mission.

  If the flag is assigned to an airfield, specific target points are marked with red triangles. For instance, an airfield attack scenario might have a runway, hangar and control tower marked for destruction. You must hit (or protect) some or all of the marked target points to win the mission.

- If you're flying with limited fuel, take along four AIM-120s, four AIM-9s, a couple of air-to-ground weapons and one or two external fuel tanks. If your fuel is unlimited, forget the tanks. Most missions will work with internal fuel and one fuel tank if you don't use afterburners very often.

- The CAS and Interdiction loadouts available in the Arming screen are good for CAP missions. (For details on these loadouts, see pp. 216-221.)

Example: Just Routine

Mission Parameters			
Flight (Callsign)	2 x F-15E (Buick)	*Recommended Loadout*	CAS
Mission	CAP	*Environment/Time*	Clear/1800

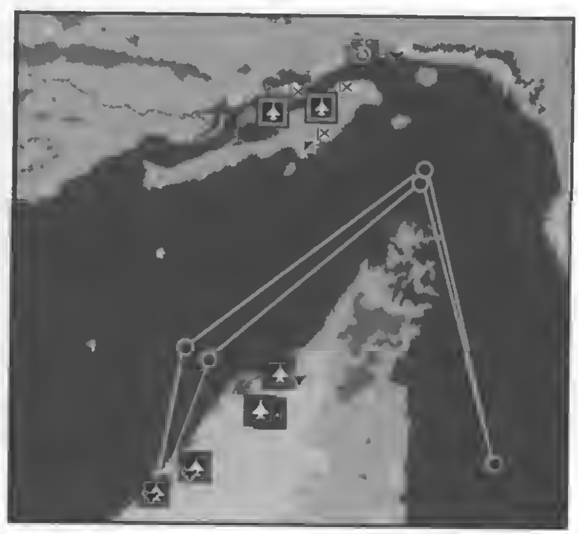
Mission Intro

This mission represents a typical combat air patrol. You take off from Dubai International airbase, fly a patrol route around the Strait of Hormuz, then return to base. If you fly the mission as instructed, you won't run into trouble. Should you stray from the mission path, or take too long, the mission suddenly becomes much more interesting.

Success	
Moderate	Complete patrol without firing on enemy aircraft or support FAC call; 65% friendly aircraft survive; no friendly-fire losses
Perfect	Complete patrol without firing on enemy aircraft; 50% special forces survive; no friendly aircraft losses; no friendly-fire losses

Check your brief map.

Before you even think about taking off, take a look at your Briefing map. The long, yellow line stretching across the width of the map represents the battle line. Above the line, Iranian aircraft are patrolling the perimeter of the boundary. Below the line, you're flying a CAP. Note that your flight path never takes you into enemy territory. If you follow the flight path and don't fire at anything unless something fires at you first, life will be uneventful. The mission looks simple from this map, but if you open this same mission in the Mission Builder, you'll notice that it can quickly become complicated.



Three things could happen:

1. You follow your waypoints as planned. When you spot the Iranian F-14 and/or Su-25 along the way, ignore them. Complete your waypoints, then land.

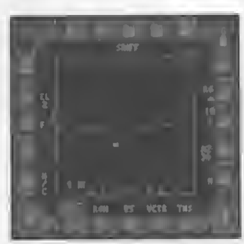
2. You engage one of the "bait" aircraft (the F-14 or Su-25). This alerts several flights of MiGs and F-4 Phantoms, which rush in to engage you. You have little hope of surviving the attack.

3. You take too long to complete your flight and receive an SOS from the FAC (forward air controller) for intelligence-gathering forces on Qeshm Island. New waypoints appear on your TSD, and your new mission objective is to support friendly forces. You must destroy forces attacking them and return home safely with all or most of your aircraft intact. (You can simply go back to base, but you won't win the mission.)

Select A/A master mode.

- Your most time-consuming task during this mission is going to be scanning the area with your A/A radar.
- You're going to want to be in A/A master mode, which displays the A/A Radar page (left MPD), A/A Arm page (center CMPD) and Tactical Electronic Warfare System (right MPD). The majority of your attention should be focused on the HUD in front of you, and on the A/A Radar MPD.

Select radar search mode.



- The A/A radar has several search modes, but you'll really only need to use RWSI (Range While Search Interleaved) mode. To select this mode, press PB 6 in the A/A Radar MPD until RWSI appears above the button in a box.

  Three range-while search *modes exist — RWSH for finding high-closure targets, RWSM for finding low-closure targets and RWSI for detecting both high and low-closure targets. (Closure indicates how fast the distance between you and another object is decreasing or increasing. Positive closure means the object is moving toward you; negative means it's pulling away. High means the distance is changing rapidly; low means that it's changing slowly.)*
- RWSI will be the search mode you use most of the time. For detailed explanations of all A/A radar search modes, see the *Expert Flight Manual*, p. 2.50.

Adjust radar range.

- The range arrows on the right side of the A/A radar MPD let you adjust the radar's range. The default range is 40nm, but it's often helpful to zoom this out to 80nm when you're on a long stretch between waypoints. To increase the radar range, press PB 14 (the up arrow).

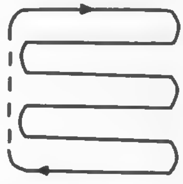
Adjust radar scan.

- Next, you'll want to adjust the portion of the sky that the radar scans.

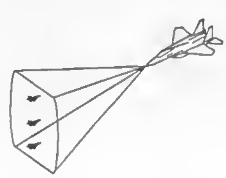
  By default, the A/A radar makes a two-bar sweep 30° to the right and left of your aircraft's nose. This is fine if a bogey is flying at approximately the same altitude as you are, but it's not good at detecting targets above or below you.
- For this mission, you'll probably want to make the scan azimuth (horizontal scan) narrower and the scan elevation (vertical scan) taller. The advantage to doing is that you will have a better chance of spotting bogeys at different altitudes.
  - To increase the scan elevation, press PB 2 (EL) on the A/A radar page. Scan elevation can range from 1 to 8 bars — set it to 8. A "bar" is basically a single radar sweep. When the radar is set to scan multiple bars, the antenna will make a sweep, then move up and make another sweep in the opposite direction. The more bars it sweeps, the greater the vertical area scanned by radar.
  - To decrease the scan azimuth, press PB 12 (AZ) on the A/A Radar page. Scanning the default azimuth, with an 8-bar scan elevation, causes the radar to update quite slowly.
- You can compensate for this narrower scan by flying a "weave" pattern, pointing your aircraft's nose left for several moments, then pointing it back right. Or, you can occasionally fly in a circle to pick up a 360° view of what's around you.

Two-bar scan

Increasing the number of bars the radar scans increases the height of the scan area.



Six-bar scan



A tall, narrow scan area will help you find aircraft at different altitudes.

You can then weave or circle to cover more horizontal area.

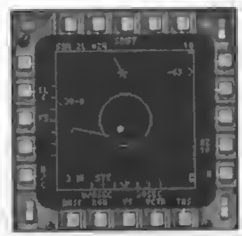
Identify bogeys.

- One you pick up radar contacts (there are two in this mission), your next step is to determine whether they are friendly or enemy.

  When the radar first paints an unidentified aircraft (called a bogey), a small rectangle appears in the A/A Radar MPD. By this icon alone, you won't be able to distinguish what type of aircraft it is. However, you can target it and then send out an IFF (interrogation friend-or-foe) query to determine its status.

  (Also, if the aircraft is transmitting radar, it will show up as a threat icon with an identifying number on the TEWS MPD. See list on p. 49.)

- To target an aircraft, use your mouse to left-click on one of the small rectangles in the A/A Radar MPD. This symbol will change to an asterisk with a line attached to it.



  This line is called a heading vector and indicates the direction in which the aircraft is moving. The A/A radar displays a top-down view of the air in front of your aircraft — if a contact's heading vector points downward, the aircraft is pointed toward you. In the picture to the right, the contact is moving away from you.

- Note that the second aircraft disappears from the radar. This is one drawback to the RWSI search mode. If you've detected several aircraft, targeted one, and want to re-display all aircraft, press [Bksp].

  Note: *A second radar search mode, TWS (track-while-scan) can display the targeted aircraft, as well as other aircraft in the area. However, it has an extremely small scan size. TWS is most useful after you've designated a target in RWSI mode and want to keep an eye on your current target, while displaying the other aircraft near it on the display.*

- Finally, query the aircraft by pressing [I]. If the asterisk flashes and turns into a circle, the target is friendly. If not, it's enemy. In actual combat missions, you'll probably want to arm your medium-range air-to-air missiles. For now, however, just practice targeting any aircraft you see, then sending an IFF query. Remember that in this mission, you've been instructed to hold your fire.

- The AN/AAQ-14 target IR pod can track airborne targets that fall within the field of view of the seek hear. If you have a target designated in the radar and have the Target IR MPD displayed, the pod will attempt to follow the target.

AIR INTERCEPT

The F-15E may be a ground-pounder at heart, but even today it preserves the heritage of its air-to-air predecessors. Historically, the F-15 series of fighters has fulfilled the air superiority needs of the USAF. The Strike Eagle version still does this, but it is just as adept at taking out ground targets as intercepting air adversaries.

An air intercept mission is normally an immediate response to incoming enemy aircraft, and often occurs in friendly territory close to base. Intercept flights are sent out to meet enemy strike fighters or bombers with fighter escorts. The offensive flight's intent is to attack strategic, friendly ground targets. In an air intercept mission, it is the defensive flight's job to prevent this from happening.

Because bombers and escort fighters maintain formation until they reach the target area, most air intercept missions take place at high altitudes. The height advantage comes into play in these battles — whoever has the most altitude possesses the immediate advantage. (Height translates into airspeed during a dive, while climbing to meet a higher foe consumes airspeed.) Height also gives your air-to-air missiles better range, since they also trade altitude for speed.

Since bombers are heavily weighted with ordnance and not very maneuverable, height isn't much of a factor when attacking them. However, altitude becomes more important against their maneuverable fighter escorts, which will break formation in order to meet an attacking flight.

An air intercept mission against a lone pair of enemy aircraft may only scramble a single flight, although two flights are the norm. If the mission is a bomber intercept, more flights may participate. In the case of bombers, each flight is tasked with a particular target — one might attack the escort fighters, for instance, while another goes after the bombers. A third or fourth flight can serve as backup and assist either group as necessary.

In the game, you usually draw the duty of destroying incoming bombers, while other flights dispense with the escort fighters. If no bombers are present, you'll take on strike fighters. Since this mission type is defensive and requires immediate response, your briefings will usually be short and to the point. Most air intercept missions have some sort of built-in timing mechanism. If you don't destroy the strike fighters or bombers in the time allotted, the mission will fail.

Playtester Tips

- In most cases, incoming and intercepting aircraft number quite a few, and the skies will be filled with both friendly and enemy aircraft.
- In bomber-intercept missions, computer-controlled flights don't always destroy escort fighters as quickly as you need them to. If this happens, you might have to knock out a fighter or two yourself.
- Don't expect non-player flights to help you with bombers after they've killed off the fighters. They rarely do.
- The biggest problem during an air intercept is distinguishing between friendly and enemy aircraft. The next biggest difficulty is telling enemy bombers and fighters apart. (Using the Casual TEWS can help here — it displays labeled, color-coded icons to ID aircraft for you.)
- Make sure you know what you're firing at before you launch! You don't want to waste precious air-to-air ordnance on a MiG if you've been tasked with the bombers.
- The IFF query function comes in handy when you're trying to ID aircraft. If you've got Expert TEWS active in the Options menu, all friendly aircraft will emit an Interrogation Friend or Foe (IFF) signal. Initially, all aircraft show up as rectangles on the A/A radar. If you left-click on one of these contacts, it switches to an asterisk, and everything else disappears off of the radar. To query the aircraft, press I. If the star turns to a circle, then the aircraft is friendly.
- If you press PB 3 on the UFC until the text beside it reads IFF AUTO, a contact will automatically be sent an IFF query when you choose it as a target.
- If you need to query other contacts, press Bksp to undesignate your current target and restore all of the blips on the A/A Radar MPD.
- Go in high whenever you're attacking enemy aircraft. The more altitude you have, the better.
- Ideally, you want to take missiles that will let you hit a bomber head on. AMRAAMs can attack a target from almost any aspect angle. This means that you don't have to fire them at the target's tail. AIM-9Ms are all-aspect as well, although the older AIM-9Ps require you to aim from the rear.

- Bombers are, for the most part, cargo planes carrying lots of weapons. It doesn't take much to destroy them, so you can hit them with whatever you want, including your cannon.
- Tu-22s have a rear tailgun — watch out for them.
- You can detect a target long before you can successively launch a missile attack. It's tempting to fire away as soon as you spot one — don't give in to temptation.
- If a bomber or escort fighter is closing fast on your nose, you can actually fire just outside the missile's maximum effective range. Since you're flying toward each other, the target will be in range by the time the missile activates. Conversely, you can't do this if you're chasing from the rear and the target is pulling away from you — don't fire unless it is well within the missile's effective range. If the target has a high, negative closure rate, the missile might expend its fuel before it could catch up.
- Try 6 AIM-120s and 2 AIM-9Ms for a bomber intercept loadout. (These aren't always plentiful in a campaign, however.)
- You can make a vertical dive down onto a bomber, especially if you're using short-range weapons.
- When you target an aircraft while your IFF is set to AUTO, a target designator (TD) box will appear around it on the HUD. If you've accidentally targeted a friendly aircraft, an "X" appears through this TD box.
- Single Target Track (STT) mode is the default tracking mode for the A/A radar. However, in this mode, all other targets disappear except for the one you've designated.
- If the air is thick with aircraft, you probably want to switch to TWS (track while scan) mode for your A/A radar. This mode lets you designate a single target but still see everything else around within your radar's field of view. This is especially useful when you're using AIM-120 AMRAAMs, each of which can be fired at a different target.

- With AMRAAMs, you can select up to eight targets before firing a single missile. When you left-click on a contact in the A/A Radar MPD, that contact becomes your primary designated target (PDT). If you select a second contact, the most recent one becomes the primary target, and the original target becomes a secondary designated target (SDT). The last contact you select is the primary target, so be aware of the order in which you select targets.

  Secondary designated targets appear as a hollow box with a heading vector, while the primary designated target has the usual asterisk or circle "head" with a heading vector.When you launch the first AMRAAM, it will aim for the PDT target. Subsequent missiles will take on each SDT, starting with the closest.

- AIM-7 Sparrows require that you keep the target within your radar's cone of view for the duration of the flight. Don't turn or pull up, or you'll lose the lock.

- AIM-9 Sidewinders (all models) hold their target after launch and follow through on the attack without the help of your radar.

- AIM-9Ps can only be fired at a target's rear, since they lock onto hot tailpipes. Carrying the AIM-9M or AIM-9L is preferable, since they're all-aspect missiles and it doesn't matter what part of the target you're facing when you fire.

- Use your Sparrows against the bombers (which don't move as fast as fighters do). Save your AMRAAMs for the fighter escorts.

- Try to get really close to your acquired target before firing Sidewinders. They operate best at close range.

- The AAQ-13 LANTIRN navigation pod is useful in any mission, but especially in missions in which you are flying low or over mountainous terrain. The navigation pod houses a terrain-following radar that continuously calculates the height of the terrain beneath you.

  It is also especially useful when flying at night — the NAVFLIR camera which it houses projects a FLIR image of the air and terrain in front of you onto the HUD. At night, this infrared image makes it easier to distinguish between the ground and the sky.

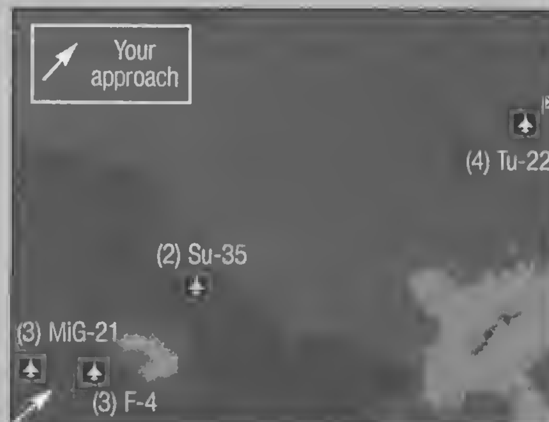
- You'll find RWSI mode best for detecting helicopters. Not in this mission, of course, but it can be useful.

Example: Fighter-Bomber Intercept

Mission Parameters	
Flights (Callsign)	4 x F-15E (Outlaw); 4 x F-16 (Medusa)
Mission	Bomber Intercept
Recommended Loadout	MigCAP
Environment/Time	Clear/1400

Mission Intro

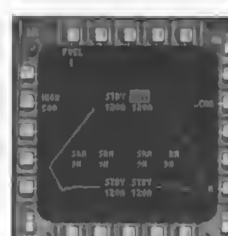
Enemy bombers and their fighter escorts have been spotted and are headed to raid a friendly airbase on Khark Island. Your task is to intercept the bombers and eliminate them before they break through friendly fighter defenses. Secondary to this, you're to take out the fighter escorts.



Success	
Moderate	Destroy all four Tu-22 bombers; 5+ friendly aircraft survive
Perfect	Destroy all four Tu-22 bombers; no friendly aircraft lost

Set up for air combat.

- This mission begins in the air. The first thing you want to do is switch to A/A master mode.
- Next, select the A/A Arm MPD in the right MPD (or press [F2] to view it on your lower MPD). This shows your air-to-air ordnance stations. Short-range missile stations are labeled SRM, while medium-range stations are labeled MRM.
- Press [3] to switch to medium-range missile (MRM) launch mode. This readies you to fire your AIM-120 and AIM-7 missiles (in this case, AIM-120s). Note that RDY appears above 120A and is boxed — this indicates that the AMRAAM is the active missile, or the missile "in priority."



- In the future, press [2] to switch to short-range missile (SRM) launch mode in order to fire AIM-9s (if you have them loaded).

- Notice that there is no key for selecting individual missiles — you simply select short-range or medium-range, and you fire off missiles within that group in a certain preset launch sequence. But what if you had, say, a mixed MRM loadout of AIM-7s and AIM-120s, and you wanted to use the AIM-7s first and save the AIM-120s for later? You can press [4] to "reject" a missile and skip to the next missile in sequence. You would keep pressing [4] until RDY appeared above a 7F or 7M station on the A/A Arm MPD.

See *Expert Flight Manual*, p. 2.26, for more information about the A/A Arm MPD.

- Now, re-display the TEWS and look for air threats and ground threats. Note that in Expert mode it will only display these threats as long as the threat's radar is active. (Casual mode displays everything that's out there — within a range you set — regardless of sensor status.)

- The above information generally means:

  - Fighters will only show up while conducting a radar scan, locking onto a target or feeding guided information to a radar-guided missile. If they know where you are, or if they are using IR missiles, they might switch off their radar and disappear from the TEWS.

  - Bombers, however, won't show up on the radar unless they're locking you up with their gun.

  - Only an *active* radar-guided missile will show up, and then only after the radar system in its nose has activated. If you were fighting Americans, this would mean the AIM-120 would show up, but the AIM-7 wouldn't.

- The TEWS also displays information about chaff, flares and jammers. By default, the TEWS automatically controls chaff and jamming. You can take care of these yourself by selecting PB 20 (MAN/SEMI/AUTO), which changes the level of countermeasure control. AUTO mode lets the TEWS drop chaff and activate jammers. SEMI lets the TEWS control the number of chaff pods dropped per release, but you release them manually. You have control of the jammer. MAN gives manual control of everything.

- *You have to drop flares manually no matter which TEWS setting is active.*

- Note that your WSO calls out threats and incoming IR and radar-guided missiles. Learn to release countermeasures on his cue.

Find bogeys.

- The bombers and escorts are directly in front of you at a slightly higher altitude. Climb up, and then get ready to search for targets.
- A quick way to identify the general direction is to request AWACS information (Shift Tab menu), if an AWACS flight is nearby. Otherwise, you'll need to search manually on your radar or by using one of the F-15E's search modes.

Select a target acquisition mode.

- You can left-click on radar blips in the A/A Radar MPD, or target them automatically. The F-15E has four missile acquisition modes, plus one gun acquisition mode. All are used to acquire targets. (These modes should not be confused with radar search or tracking modes. Search, acquisition and tracking modes are discussed in the *Expert Flight Manual* on pp. 4.29-4.30.)
  - **Supersearch** acquisition mode (5) will pick up bogeys that pass through a 20° cone in front of your aircraft. Although this mode looks for targets in a large area, range is limited to 10nm. This is good if you're trying to pick up the closest target in a missile fight or flying CAP and covering a wide area with your radar, but not if you're trying to pinpoint a pair of inbound fighters and know their exact direction of approach.
- For this mission, use the super search mode. The bombers and their escorts are a mere 17nm ahead of you, and closing fast.
  - **Long-range boresight** (7) looks for targets in a very small area just around the waterline (-w-). In this mission, you won't need to use this mode. However, if you ever request a bogey picture from an AWACS aircraft (Shift T, then 1), you can change course to match that bearing and use this mode to detect fighters up to 40nm away. You can do the same if you know the bearing of an attack on a friendly facility that you've been sent to protect.
  - **Boresight** (6) also looks for targets in a small circle around the waterline. This mode is best applied when you know the bearing of an approaching fighter or group of bombers, and they're already within close range (10nm or less). Or, if you're on someone's tail and want to maintain a lock on that specific target, use this mode.

- **Vertical scan** mode (8) probably won't be too useful in a missile fight. This essentially turns the radar scan vertical instead of horizontal, meaning you can then find targets in a tall, but very narrow, band of detection in front of your aircraft. It is generally reserved for close-range fights in which you're trying to acquire an enemy in front of you as he makes a break turn to evade you. The taller, vertical scan will let you track him further into the turn than you can with other modes.
- **Guns acquisition** mode activates automatically when you select your gun while in ATA master mode. Its range is barely 5nm, but it has a large acquisition area. The different gunsight modes are discussed later, on p. 67.

Find and track a Tu-22 bomber.

- The hardest part of this mission is sorting out the bombers and fighters in front of you. There's no easy way to tell them apart. With ground targets, you can at least use the Target IR MPD to see a FLIR image of the target. Air targets won't sit still long enough, so you can't rely on imaging to distinguish one plane type from another. You can send an IFF query (I) to discern between friendly and enemy planes, however.
- You can play with the CASUAL TEWS option active — the TEWS then shows bombers even when they aren't using radar, and identifies threats for you.
- If you don't want to do this, one trick that can help you ID your target is to pause the game and enter the Reverse Tactical view (Shift F7 in the default key map). This gives a view of your target, and of your aircraft from your target's perspective — which tells you a bit about how to turn to find that target.
- There's no easy way to identify a bomber legitimately. You can make an educated guess by checking a target's closure rate — if it is fairly low even when he's approaching you head-on, he could either be a bomber or a slow-moving fighter. If the closure rate is really high, it's most likely a fighter. (Subtract your speed from the closure rate to estimate your target's speed.)
- Once you're fairly certain that you have a bomber designated, you may want to switch to *track-while-scan* (TWS) mode. This allows you to track the target you've designated, but it also keeps other air threats displayed on the radar.

Note: *You can't activate TWS if you have an AIM-7 ready. It allows you to track only a single target, and requires that you keep that target within your radar's cone of sight until it hits.*

- TWS mode is especially useful when you're using AMRAAMs because you're able to designate primary and secondary targets. Once you have several contacts in the A/A radar MPD, you can pause the game and left-click on all of them. (If you haven't designated a certain target before you activate TWS mode, the closest contact will be automatically targeted.) The last one you select is your primary designated target (PDT), while the first ones you select are secondary designated targets (SDTs). The first missile fired will go for the PDT, while others go after the SDTs.

Fire an A/A missile.

- Once you've got a bomber designated, the rest is easy. Maneuver so that the target you see in your A/A Radar MPD is in front of you. It will appear as a speck in the sky with a target designator (TD) box around it. (If you've sent an IFF query and the TD box has an "X" through it, then the target is friendly.)
- When the target is within range of the weapon that is in priority a shoot cue will flash beneath the TD box. (See the pictures below.) When you see the shoot cue, fire using joystick button 2.

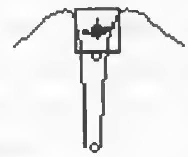
- You won't see the cue until (a) the target is within missile range, and (b) the missile has a lock. If the cue is flashing, you're in optimum firing range. If it doesn't flash, you can still fire, but the missile may run out of energy before it catches the target. Or, the target might evade it. (Several subtle firing considerations can improve your missile's chance of hitting. See the *Expert Flight Manual*, pp. 4.34-40, for complete instructions.)

Note: *If a large X fills the HUD when the target is in your radar's cone of view, your target has moved inside the selected missile's minimum range. You will need to adjust your position, or select a shorter-range missile.*

- AIM-9Ps must be fired toward a target's rear, but the other air-to-air missiles you can load are all-aspect. This means you can be facing the target at any angle when firing.

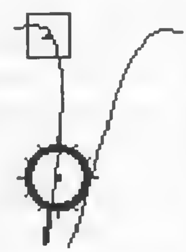
If you need to, use your guns.

- Normally, you won't rely on guns. Use them only when you're short on missiles or happen to be too close to an enemy aircraft to fire a missile.
- Press [1] to select your gun. This places a funnel-shaped curve onscreen, which twists and changes shape as you maneuver. You stand a better chance of hitting targets near the open mouth of the funnel (targets that are within 1000ft) than targets at the smallest end of the funnel (targets within 3000-4000ft). Maneuver so that your target is "inside" the funnel, then press the joystick trigger to fire.
- The funnel is useful if you understand its purpose. If you have a long, skinny funnel, it means you're currently pulling hard-G maneuvers to bring the target into your bullets' range. A wide, short funnel means you're not maneuvering very sharply. Either way, you want to maneuver so that your target's wings touch both edges of the funnel (see the picture below). In other words, the target's wingspan should "fill" the width of the funnel. If the wings don't touch both edges, then you want to maneuver so that he's further down inside the funnel.



Target properly aligned in gun funnel

- If you have a target designated with your radar, you have a second gunsight option. Pressing [1] again places a round GDS reticle onscreen instead of a funnel. This is slightly easier than using the funnel — here, steer so that you place the reticle up on top of the target, then fire. The reticle indicates the point through which bullets will pass at you're target's range.



Here, you would want to maneuver until the target in the TD box was nearer the neck of the funnel where the reticle is.

- Pressing [1] a third time displays both the funnel and GDS reticle. If you normally use the reticle, you may want to use this mode to get a feel for how the funnel works. Just line up the reticle and the target, then pause to see where the target falls inside the funnel.

STANDARD BOMBING RUN

The F-15E is a strike fighter, and bombing fits well within its repertoire of attack capabilities. Just about every strike task that isn't specifically geared toward ground threats, airfields and ships fits into this category. For instance, targets may include factories, bridges, roads, hardened command bunkers and strategic buildings. If the target is well defended, a Suppression of Enemy Air Defense (SEAD) flight may be sent in ahead of a bombing flight in order to clear out dangerous SAMs and AAA sites.

Although sheer explosive power is the hallmark of a bombing attack, guided munitions have their place in ensuring mission success. Sometimes, the target of a bombing attack will be adjacent to civilian facilities. Or, only the destruction of *part* of a target is necessary to deny the enemy immediate, military use of its resources — i.e., taking out fuel tanks or pipelines in lieu of taking out a refinery. In these cases, using precision-guided munitions ensures that a) weapon expenditure is kept to a minimum and b) only the intended target is damaged.

To ensure that no unintended targets are hit, the attacking flight must first designate the correct target. A good visual ID or infrared image of the target is necessary for weapons launch, and the launching party must be sure that the target is indeed a strategic objective. As witnessed during Desert Storm, misguided precision weapons can have disastrous results. Two cases in point are the destruction of a civilian shelter using an laser guided bombs, and a Hellfire attack on friendly tanks by an Allied helicopter.

Playtester Tips

- Once you've successfully fulfilled your mission objective, you can press Esc to end the mission. This is especially useful if you're running low on fuel.
- If you're still learning, use the EASY LANDINGS and CRASHES OFF options. That way, you won't get through a mission only to crash during your landing.
- If you have a hat on your joystick, press the hat down to see a head-down view of the cockpit. (F2 will accomplish the same thing, and F1 or pushing the hat up will restore the normal cockpit view.)

- Here's a general tip — if you make a custom keymap, you can open it as a text file and print out a list of your new keys and their functions. The file is in the *Jane's/F15* folder on your hard drive (or in whatever folder you chose during installation) and has the name you specified, followed by INI (for example, MYKEYS.INI). Don't modify this file outside of the game, however!
- After you take off, tell your wingman to engage targets of opportunity. To send this message, press Tab, then press 4 to select WINGMAN from the message menu. Select GROUND TARGETS (press 6), then TARGETS OF OPPORTUNITY (press 3).
- The above command can be assigned to a custom keymap by adding the ATK_ANY_GRND function to an unmapped key.
- If you don't have specific targets to hit, circle the target area and scan with your A/G radar until you detect targets. Keep your altitude under 1000ft.
- Make sure you keep A/G master mode active. If you accidentally switch to A/A master mode, you won't be able to see any ground targets.
- You have to load countermeasures onto your aircraft for each mission. If you think you'll be facing a lot of SA-13s, take along the package with the most flares. If you're facing predominantly radar-guided SAMs, take more chaff. The following packages are available: *AN/ALE-40(1)* — 120 chaff/60 flares; *AN/ALE-40(2)* — 180 chaff/30 flares; or *AN/ALE-40(3)* — 60 chaff/90 flares.
- Your TEWS won't control flare release. Even in AUTO countermeasures mode, you have to manually drop flares (Ins).
- SA-13s fire heat-seeking infrared missiles. If your WSO calls for flares, dispense flares, then turn your afterburners off (press \).
- Sometimes in a mission, you'll be ordered to *not* hit a certain target — for instance, you might hit fuel tanks, but not refineries. Precision weapons (i.e., Mavericks and the GBU bombs) are best for these occasions. Chances are that if you hit something you're not supposed to, you'll fail the mission.
- The standard loadout in the Arming screen is good for bombing runs against medium-sized targets — command bunkers, fuel tanks, etc. Most of these are dumb bombs. For your guided weapon needs, try the Smart Bomb loadout.
- Low and fast is the best approach for a mission against tanks — you're usually traveling 600 knots or faster, and it's hard for tanks to fire at you.
- If you're attacking a large target or using self-guiding weapons, you can afford to go in high. It keeps you out of AAA range and some SAM ranges.

Example: Chemical Attack — Iraq

Mission Parameters	
Flights (Callsign)	8 x F-15E (Outlaw); 6 x F-15C (Medusa); AWACS (Bandsaw)
Mission	Strike
Recommended Loadout	Standard
Environment/Time	Partly Cloudy/1955

Mission Intro

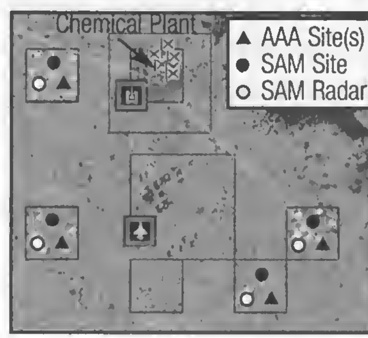
This mission represents a standard bombing run — your flight's objective is to attack a chemical weapon production facility in the Mid-East. The attack must be swift and accurate to avoid fighters that will most likely scramble when you arrive. For political reasons, you've been instructed not to engage any other targets of opportunity, including enemy aircraft.

Success

If you use this mission for countermeasures practice, the objective is simply to stay alive.
To win this Single mission, however, you must meet the success parameters listed below:

Moderate	Destroy four northernmost buildings, damage SE building; 65% friendly aircraft survive
Perfect	Destroy all buildings (or at least destroy the four northernmost buildings and damage the SE building); no friendly aircraft losses

Find the complex.

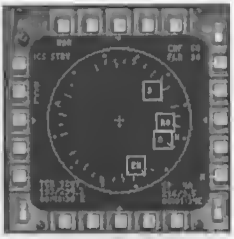


This is another nighttime bombing mission, but you shouldn't have a hard time finding the targets. You've been tasked to hit five different buildings in the complex, and they're all clustered together. As soon as you approach steer point 5A, start looking for green specks in your A/G Radar MPD. If you follow your steer points, you'll fly toward the target area.

Note: *Since this mission has so many SAMs and AAA, we are going to concentrate here on teaching you how to avoid them. If you want to also make a bombing run, the methods for finding targets and engaging them are discussed under* ***Combat Air Patrol****, p. 50, and* ***SEAD****, p. 80, respectively.*

Avoid ground threats.

- If you're flying this mission strictly to learn how to avoid ground threats, make a low-altitude run. SAMs will have a harder time tracking you.
- Not getting shot down is going to be your biggest problem in this mission. Anti-air defense is heavy — strikes on most strategic targets will require you fly within range of the SAMs that are protecting them, and this one's no exception.
- SAMS send out radar spikes when they're trying to acquire you. Your WSO will identify these radar searches as "mud spikes."
- A SAM's TEWS icon will flash when it is launching a missile at you. Arrows on each side of the TEWS flash to let you know from what direction the missile is approaching. If it's on your left or right, you stand the best chance of evading it. If you're being tracked by a missile, turn toward the flashing arrow (if it's on the left, for instance, steer left). Missiles expend most of their fuel and energy by tracking you into the turn. You want to keep your speed as high as possible to make them maneuver more.



Note: *Some missions (but not this one) have SA-13 SAMs, which fire IR-guided missiles. This turning technique won't work in theses cases. Instead, drop flares, shut your afterburners off and get out from between the flare and the missile.*

Use countermeasures.

- At first, you'll probably want the TEWS to take care of chaff and jamming. You must always drop flares manually, however (press (Ins)).
- When the TEWS countermeasures setting is AUTO, you'll get an audio cue each time the TEWS drops chaff or activates jamming. (The TEWS dumps chaff rather quickly. When you're a little better at evading missiles, switch to MAN mode and drop these yourself.)
- If you're in SEMI or MAN mode, you'll have to manually turn on your jammers on (J) and manually drop chaff (Del).

CLOSE AIR SUPPORT

Close Air Support (CAS) missions involve attacking ground targets, not air targets. They are offensive in nature instead of defensive. A Strike Eagle flight on a CAS mission has predetermined targets gathered by intelligence forces, and the sole purpose of the mission is to take them out. The idea behind a CAS effort is to soften up enemy ground targets prior to the arrival of friendly ground forces. Or, friendly ground forces may be under attack and need help defeating enemy ground forces from above. Therefore, most Close Air Support missions take place either behind enemy lines or on an advancing battle front.

The targets assigned to CAS flights are limited to vehicles or emplacements that could potentially harm friendly ground forces or arriving attack aircraft. These high-threat targets include tanks, mobile and stationary SAM sites, and long-range artillery. Larger targets like airfields and stationary radar sites are left for the arriving strike or SEAD aircraft.

In a CAS mission, you typically make a high cruise approach. Once you're within detection range, you drop to a lower altitude to avoid being detected by enemy radars and SAMs. (Think of their detection area as a large cone standing on its tip — near the ground, the detection range is small. As the cone travels upward, it moves outward, and the detection range increases.) On your exit, you'll fly out low, then gradually climb to a safe cruise altitude.

In the game, Close Air Support missions are among the most difficult tasks you'll be handed. Small targets on the ground are hard to find and even harder to hit. CAS flights are a bit easier in Single missions than in Campaign missions, at least as far as ordnance is concerned. In the Campaign, you're trying to manage finite supplies of aircraft, dumb bombs, guided bombs and missiles. In Singles, you don't have to worry about conserving certain weapons for later missions.

Playtester Tips

- CAS missions usually send you to a specific target area (check your briefing). If it's a CAS mission, it will usually mention a friendly advance.
- You can play with the INVULNERABLE and/or UNLIMITED AMMO options active in Single missions. However, they automatically deactivate in Campaign missions.

- You will need to make HRMs to pick out your target (see p. 23 in this book, or p. 4.53 in the *Expert Flight Manual*). If you can't find a target in your map, change altitudes or adjust the radar scan. At higher altitudes, you get more range but less detail. Lower altitudes give better detail, but less range.

- If you get an error message when you click on the radar screen to command a map, your radar can't "see" well enough to create a map. You either need to turn slightly to avoid the "blind" radar spot that occurs at 8° to the left and right of your aircraft's nose, increase the radar's range, or decrease the HRM size.

- Since you'll often be flying low, near SA-13s with IR missiles, you may want to take along a flare-heavy countermeasures package. Do this in the Arming screen before you take off. First make a pass to find those SAMs (dropping flares all the way) and take them out before you start hitting other targets.

- Press F2 to pop down and look at the TSD every so often, or pull up the TSD in the right MPD in place of the A/G Arm page. (If you have a joystick with a hat, push the hat down to switch to the F2 view.)

- If you know you'll be facing tanks, carry Mk 20s (unguided bombs) or AGM-65s (guided air-to-ground missiles). Mk 84s are great if you're into large explosions, but it's a shame to waste them on smaller targets.

- The Jump function can be really useful for long-range CAS missions. It lets you skip all the way into enemy airspace and places you at the waypoint nearest to the target area.

- If you're having trouble with attacking or navigating at the correct altitudes, try switching to Casual flight mode for a mission or two. By using the Autopilot function in Casual mode, you can watch to see what altitudes work best for each waypoint. Be careful about autopiloting in Expert flight mode, however — by default, Expert autopilot maintains your current direction and angle-of-attack. Even if there is a mountain in the way, it won't readjust your altitude or direction.

- Flying high on the way to the target area is the most fuel-efficient way to fly. Usually, 25,000ft of altitude and 350 knots of indicated airspeed works well. If you're not concerned with fuel, you can fly low to avoid radar detection, but you can't see as well.

Example: TACAIR (Detection Phase)

IMPORTANT! To avoid information overload, this single mission has been divided into two phases — detection (finding and acquiring targets) and attack (using air-to-ground weapons against targets). The first phase is discussed here, under Close Air Support. The second phase is discussed under ***Suppression of Enemy Air Defenses****, p. 80. The mission itself is a CAS and SEAD combination mission.*

Mission Parameters	
Flights (Callsign)	4 x F-15E (Charger); 2 x F-4G (Raven); 6 x Jaguar (Cortland) Numerous other AWACs and supporting aircraft.
Mission	CAS/SEAD
Recommended Loadout	LONGCAS, but replace one rack of Mk 20s with four GBU-12s and add the AN/AAQ-14 pod.
Environment/Time	Clear/1430

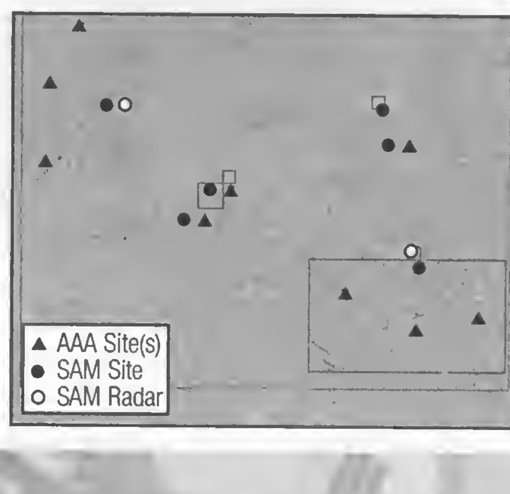
Mission Intro

In this mission, coalition forces are about to move in on dug-in Iraqi positions on the coastline of Saudi Arabia. Your flights' job is to help the Jaguars soften up the Iraqi air defenses prior to a massive airstrike. Destroy as many AAA and SAM sites as your weapon load allows.

Success	
Slight	Destroy 16% to 40% enemy ground targets; 70% friendly aircraft survive
Moderate	Destroy 41% to 70% enemy ground targets; 70% friendly aircraft survive
High	Destroy 71% of enemy ground targets; 70% friendly aircraft survive
Perfect	Destroy 71% of enemy ground targets; no friendly aircraft losses

Before You Take Off ...

You're going to need air-to-ground weapons for this mission (Mk 20s and GBU-12s), a few air-to-air missiles for enemy aircraft on CAP, a FLIR pod, and some extra fuel for the nearly 300nm trip north to the target area. The recommended LONGCAS loadout includes most of these, but you'll have to add the pod and GBU-12s using the CUSTOM loadout button.



After takeoff, head for your next steer point.

- It's a long way to the next steer point, so unless you'd like to spend some time cruising, you might want to use the Jump (Shift J) function.
- If you're having trouble distinguishing your HUD readout from your forward cockpit view, you can change the color of the HUD display by pressing Help until you cycle through to a color you like.
- Jumping drops you just outside the target area at Nav 3A and at nearly 20,000 feet of altitude. At this point, the Jaguar flight splits off to the north to take on a group of SAMs and AAA.
- While you're still in Nav master mode, note the triangle on your A/A radar page. This is your target sequence point, or in simpler terms, the last waypoint before you hit the target area.
- As you approach the target area and prepare for your attack, go ahead and issue your wingman the command to attack the primary target (Tab, then 1, 8, and 1). That way, he'll get into action as soon as you arrive.

Activate A/G master mode.

- Now, you're going to want to switch to your A/G radar in order to scan the area for targets. Cycle through to A/G master mode (press M until A/G lights up on the bottom of your screen). This displays your A/G radar in the left MPD, the TEWS MPD in the right MPD and the TSD MPD in the lower, center CMPD. See **Quick Reference,** p. 49, for A/G radar pushbuttons and symbols.

Select the radar mode.

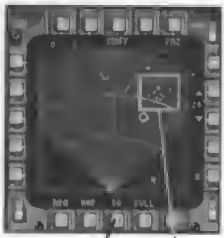
- The A/G radar has four modes. Only one mode is mentioned in detail here — RBM (real-beam map) mode. This mode is what you'll need to detect stationary targets on the ground. RBM is selected by default on PB 6, and you'll want to use this mode most of the time.
- For moving targets in other missions, you can use GMT, or ground-moving target mode, which is discussed in the *Expert Manual*, p. 2.46.

Find the target area.

- Fly through the next steer point, bank right, and proceed forward toward your target sequence point, making sure you keep your altitude constant. (Steer points appear on your A/G radar screen as circles.)

- As soon as you spot light-green clutter near the center of your radar, zoom the radar in from 40nm to 20nm (left-click PB 13, the down arrow). This will provide a close-in view of the area.

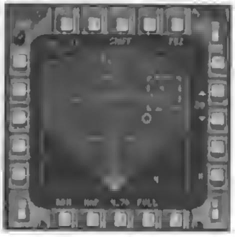
- Fly forward and veer slightly left to move the clutter off center. When it's approximately in the right, middle section of the MPD, pause the game (Alt P) and study your radar.



- By default, you are using the radar cursor's MAP function (versus the Target (TGT) function). The current map size is 4.7nm square. (As a side note, each time you zoom in the radar, the map size gets smaller as well.) Since you want to see a smaller area than 4.7nm, reduce the map size by pressing PB 8 once. The screen doesn't change any, but the map size you are about to create will be 3.3nm square.

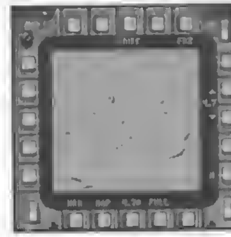
Make a High Resolution Map (HRM).

- Now, move your mouse cursor around in the MPD and notice that a dashed box appears. This box represents the 3.3nm square map size you just selected. Place it over the green specks on the right and left-click. The entire MPD will be redrawn with a high-resolution map that is 3.3nm x 3.3nm. Notice that above PB 6, RBM has changed to HRM — this means you're in HRM mode.

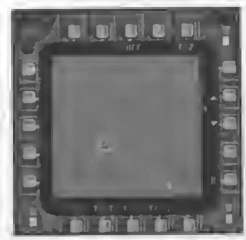


- Certain areas on the radar screen are blocked off as "blind"areas (see p. 79). If you can't create a map where you want to, turn your aircraft to place the area you want to map between 8° and 60° to the right or left of your nose.

- Note that your dashed square still appears onscreen in the MPD, but now it fills the entire display. The dark specks on the map are terrain features and ground objects picked up by the radar.



- If you want to make an even smaller map to zoom in on particular specks, press PB 13 (the down arrow). These are the same arrows you use to zoom in the radar. However, when you're viewing a HRM map, you use them to change the map size. In the normal radar view, however, you use PB 8 to change the map size. Yes, it's confusing, but you'll get used to it in time.



- Again, move the box over specks you want a closer view of, then left-click. A second, smaller map fills the display.

(The above text overviews the basic process of creating HRM maps. Detailed steps appear in the *Expert Manual*: pp. 4.53-4.58.)

The high-resolution maps you can create in the A/G Radar MPD are a key factor to playing the game. Most of the ground objects you're going to be attacking are stationary, so learning how to effectively use HRM (High-Resolution) maps will give you an advantage. At long range, you can use a rough radar scan to check for threats in an area, then use a zoomed-out HRM map to determine general terrain features. Then, you can select smaller areas where you suspect targets lie in wait and generate a zoomed-in HRM map.

Although generating the patch maps can take up to six seconds, the maps are very useful and can provide a square map covering anywhere from .67nm to 40nm. Since their images are static (non-updating), HRM maps are mostly useful against stationary targets.

Designate a target point.

- Now that you're ready to pick out a target area for your weapons, you'll need to switch to the radar cursor's target (TGT) function. Press PB 7 (the text above it switches from TGT to MAP).

- Now, when you move your mouse around in the screen, you don't see a dashed box. Place your cursor over something you think might be a SAM emplacement and left-click. A green triangle appears on the screen — this denotes a target point.

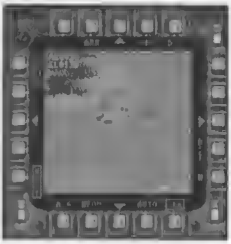
- One very important thing to remember is that you aren't targeting a specific object when you do this. Instead, you're designating a point on the ground where you want to aim your weapons. Guided weapons (except for IR-guided ones) will home in on this spot that you designate.

- It can be very hard to verify exactly what's in the area you've selected — or even to determine if the area contains friendly or enemy targets.

  - To see what the target looks like before you take off, click the TARGETING button in the Briefing screen. A small picture of the target is displayed at the bottom of that screen.

  - If you load the AN/AAQ-14 targeting pod, you can use the Target IR MPD page to see what you have targeted. This is most useful at close range, when enlarged infrared images can provide an accurate visual ID.

    Once you've designated a target, pull up the Target IR page in the right MPD. The target IR camera will automatically center on your currently designated radar target. You can use PB 7 (WFOV/NFOV/ENFOV) to zoom in and out for a better look.



Target centered in Target IR MPD

    If the area (or object) in the center of the display isn't your target (in this case a SAM or AAA site), move your cursor back to the A/G Radar page in the left MPD and click on another possible radar site, then see what appears in the Target IR MPD. Click on different spots until you find something.

- If you do find a target with the Target IR camera, but it's a little off-center in the Target IR MPD, you can fine-tune the designation:

  First make sure you are in MAN mode, and that TRK (PB 10) and CDES (PB 1) are ***not*** boxed — if they are, click these buttons to unbox them.

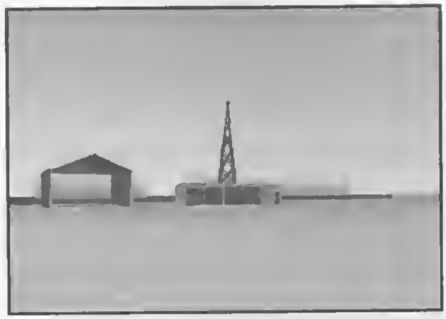
  Then use the arrow pushbuttons to center the target IR camera on your target.

  Press TRK (so that the Target IR camera will continue to track the object) and CDES (to designate the point in the center of the Target IR camera as your new target).

- Finally, if you still can't find what you're looking for, you can always "cheat" to find out what's nearby using the Reverse Tactical view (Shift F7).

  Press Shift F7 to switch to reverse tactical view. This shows you a "subject" in the foreground and your aircraft in the background.

  You can also cycle through .different subjects and see where they are in relation to your aircraft. Press F11 to cycle through stationary ground objects. This key cycles through both friendly and enemy — nearest to farthest.

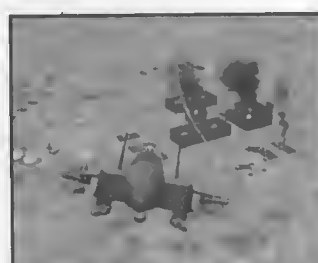


***Same target viewed with* Shift F7**

You are the tiny speck just above the horizon to the right of the tower. Unfortunately, you are too far away to be able to tell where the target is in relation to your aircraft. Try pressing F7, which will put your aircraft in the foreground and the target in the background.

- Experiment with picking different specks for targets and using the Shift 7 view to see what they are. If you find something you want to zoom in on even further, you can switch back to Map mode and try making a smaller HRM map. If you can't because of the blind zone or radar scan limits, you may need to go back to RBM mode (press PB 6), unpause the game, change your aircraft's position, re-pause the game, and make a new HRM map.

- Once you have a satisfactory HRM map of your target area, make sure the game is paused. Then, read the next section on SEAD missions. This walkthrough resumes on p. 84 and discusses how to fire your aircraft's guided weapons.



Same target, in flames

SUPPRESSION OF ENEMY AIR DEFENSE (SEAD)

Suppression of Enemy Air Defense is the systematic process of identifying key air defense threats and suppressing, neutralizing or destroying them. Targets are carefully selected, and only the necessary weapons are expended to accomplish the mission. These are perhaps the most important missions of all, in that a huge amount of responsibility is pinned on the SEAD aircraft. It is the SEAD flight's job to clear out the most dangerous surface-to-air weapons in an area. After that happens, a flight of strike aircraft arrives to take out other tactical targets.

The SEAD flight's timing must be impeccable and its weapons accurate. Otherwise, the inbound strike aircraft will face more ground fire than they expected. The entire purpose of the SEAD mission, after all, is to pave a safe flight corridor for other flights.

Attacking SAMs in a SEAD mission is different than taking out SAMs one by one at an airbase. Most of the time, heavily defended areas will have semi-permanent SAM emplacements — a group of four SAMs surrounded by concrete or sitting on concrete slabs. Many times, a single radar will serve all SAMs in the group. Although this gathering of weapons is a a bit easier to spot than a lone, mobile SAM site, it poses a much larger threat.

If you're tasked with a SEAD flight in the game, SAMs won't be your only targets. Sometimes, you'll be assigned radars or Scud launcher trucks. The key factor to successfully completing a SEAD mission, especially in the Campaign missions, is to avoid overkill. Only destroy what you need to in order to make the area safe for inbound flights.

Playtester Tips

- SEAD targets won't always appear on the mission map you see before takeoff.
- SAMs can spike (track you) as low as 200 feet. AAA is dangerous from any low to medium altitude, but if you go up to 10,000 feet, they can't tag you.
- You can use terrain to shield your aircraft from ground-based radars. If mountains are near the target area, make your approach from behind them.
- Take the heaviest weapons you can carry. If there's nothing around that you want to avoid hitting, BSU-50s (Mk 84 AIRs) are always a good bet — they have a really large blast radius. The targets you're looking for are usually bigger than airfield targets, and sometimes hardened.
- You'll be assigned a pre-determined targeting area before the mission starts. Once you get to the waypoint before the target area, start your preparations. Almost always, the area will be defended by AAA and SAMs.
- If the TARGETING button in the Briefing screen is lit up, use it. It only lights up when you're being assigned a specific, stationary ground target to hit. This screen gives you the opportunity to see an image of what you're supposed to hit.
- After you take off and start cruising toward the target, select a bomb from the right MPD. To do so, left-click on one of the pushbuttons (AGM-65 or Mk 82, for instance). A box will appear around the bomb name that you select. To de-select a bomb type, left-click its pushbutton a second time.
- A lower approach is better for creating HRM maps and getting good radar scans, but only if there isn't much AAA. (SAMs aren't as threatening at low altitudes.) If you're using cluster bombs for anti-armor or anti-personnel attacks, a low approach is best.
- You may want to assign dangerously placed SAMs to the division or element of your flight, and take care of others yourself. You can do this in the *Targeting* screen before you take off.

  To do so, left-click the large button with the green triangle on it, then left-click on a flight number. Finally, left-click on the target you want that flight to hit. This causes a green triangle to appear on that target.)

- If you're confident that you can handle multiple targets, you can tell your wingman to attack things that aren't really relevant to the mission, but that are good tactical targets. Remember to do this before you take off (as described above).
- You can't change a flight's targets once you take off.
- You can double-team SAMs if you have extra airframes to spare in the campaigns. This will allow your flights to take them out much more quickly, which gives you a better chance of survival.
- Giving orders is a large part of the game. When you press Tab, you see a list of message recipients in the upper left corner of the screen. Tasking different recipients for separate tasks can be helpful in a hectic battle. You can select a recipient as follows:

WINGMAN	Selects wingman as recipient.
FLIGHT	Selects wingman and aircraft 3 and 4 as recipients.
DIVISION	Selects aircraft 5, 6, 7 and 8 as recipients.

- Anti-aircraft sites can be difficult to find. You can use the TEWS to help.

  If you're using the TEWS in Expert mode, it gives you the threat's bearing in relation to your aircraft, but not range to the threat. Turn so that the site you are interested in is at the top of the TEWS in order to place the threat directly in front of you. You can then use the radar to make HRM maps of the area in front of you and use your FLIR targeting camera to find and target the threat.

Example: TACAIR (Attack Phase)

IMPORTANT! The process of finding and designating a target point is covered in the detection phase of this mission, under **Close Air Support***, p. 72. The rest of the walkthrough presented here assumes that you've found something of interest you want to destroy — preferably a SAM or AAA site.*

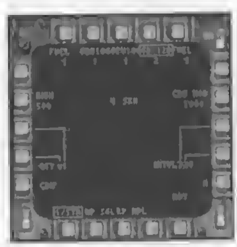
Mission Parameters, Mission Intro and Success
For mission parameters, see the first half of this mission (**Close Air Support**, p. 74).

This walkthrough will cover how to drop a laser-guided bomb on a targeted area. (The process for dumb weapons is the same, except that you don't need to use the laser.) Make sure you've adjusted the CAS loadout to include a rack of four GBU-12s and the AN/AAQ-14 pod. (For instructions on using your other guided weapon, AGM-65D Maverick air-to-ground missiles, see the **Training Missions**, p. 10.)

Select a weapon.

- It doesn't take long to gear up for battle, but it's imperative that you do so. Otherwise, you'll have a nice, fat target in front of you that you can't attack because you haven't selected and armed a weapon.
- First, make sure you're in A/G master mode. Then, in the left MPD press M to display the main MPD menu. Select PB 3 to display the A/G Arm MPD. The top row of pushbuttons on this page lets you know what types of weapons you're carrying, and how many.
- Select the GBU12 pushbutton — a box will appear around the guided bomb text.

  You could select AGM-65D at this point, if you prefer to use them. (See **Training Missions**, p. 10, for details.) However, you should preserve these precision weapons for the smallest of your targets. You stand a fair chance of hitting a group of SAMs with a guided bomb, but scoring a hit on a single SAM or AAA site is more difficult — an A/G guided missile is much more useful.

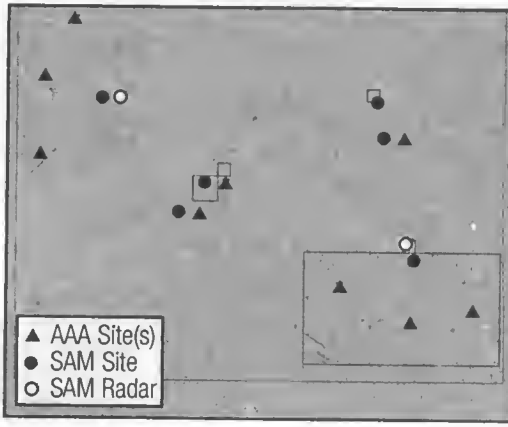


Select a bombing mode.

- Also in the A/G Arm MPD, you'll need to select a bombing mode. You have three at your disposal — CDIP, Auto and Auto Loft. (See pp. 166-167 for a discussion of each type.)
- For this mission, left-click PB 5 until AUTO appears.

Find a target.

- Using the instructions given in the detection phase of this mission, pick out something you want to hit. You'll want to select a target that's at least 10km away so that you have time to set up your attack. The map to the right might help you locate some targets.



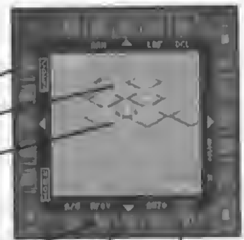
- The TEWS (Tactical Electronic Warfare System) MPD will come in very handy when you're looking for SAM sites and AAA. These targets are very difficult to spot with even a .67 HRM map, but the TEWS can help you identify their general position. So can your WSO, who can often be heard shouting "Mud Spike at eight o-clock!"
- Threat symbols will appear on your TEWS if they're transmitting radar. Each symbol describes the position of a ground threat. (See p. 49 for a list of codes.)
- On the TEWS, aircraft is in the center, and threats appear around you according to their position and radar signal strength. (The stronger the signal, the closer to the center the threat appears.) Although the TEWS won't let you target anything, you can use it as a guide to locate that target. Just fly in that general direction.

Activate the Target IR MPD.

- You've already selected your weapon, so you don't really need the A/G Arm MPD displayed anymore. Press M and then select TGT IR. (If you get the NO FLIR message, then you didn't load the AN/AAQ-14 pod. You'll need to add it in the Arming screen prior to takeoff.)

- This MPD displays an infrared image of the area you have targeted on the ground. Besides a FLIR camera, the pod also houses a laser you can use to illuminate ground targets for laser-guided bombs. Additionally, the Targeting IR page symbology can give you a pretty good idea of whether your guided weapon is on the mark or not — the IR targeting camera automatically slews toward whatever A/G target you have selected.

Target IR MPD



  The pod has two modes — AUTO and MAN (manual). In AUTO mode, the pod will attempt to track a target you've designated on the A/G radar, as long as it is within the pod's field of view. You'll probably want to use this mode almost all of the time.

- Without a target designated, the *tracking gate* indicates the area directly in front of your aircraft's nose. Whatever target is inside this gate will be tracked if the TRK pushbutton is boxed. (This tracks the target point on the ground, not the target itself. If you've designated a moving target, the IR camera will not follow it unless you select CDES, the continuous designation function.) Since you've designated a target, the view is already centered on the target.

- When TRK is boxed, you'll get a short status message in the bottom right corner of the display. PT-TRK (point-track) will appear if you've targeted a man-made object (a building, truck, etc.). AR-TRK (area-track) will appear if you are tracking terrain.

- Obviously, it's much easier to see and target large objects with the Targeting IR MPD. Smaller objects are more difficult to track, especially at long range.

- The *pod LOS cue* shows the targeting pod's line-of-sight. This shows where your laser is aiming, and also gives you a good idea of the approximate azimuth (horizontal) and elevation (vertical) visibility of the targeting FLIR.
- You can use the Targeting IR MPD's MAN (manual) mode to adjust the camera, select a different target, or to target a smaller part of a large target.

  To make slight adjustments to the camera view in manual mode, left-click PB 10 to unbox TRK and unlock the camera, then use the arrow pushbuttons to adjust the camera position.

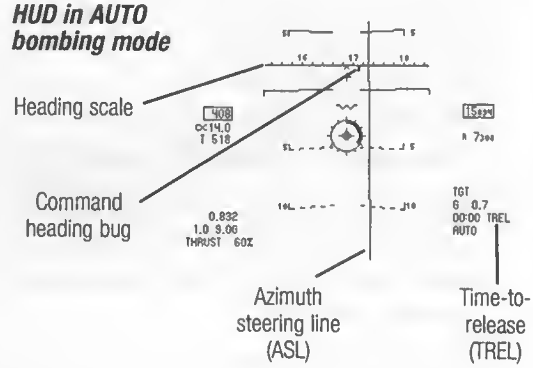
  You can adjust the detail of the Target IR image by pressing PB 17. This switches between long-range FLIR (LRF) and short-range FLIR (SRF). LRF gives you the best range, but sacrifices picture detail. Oppositely, SRF gives you a more detailed picture, but has limited range.

  Once you've adjusted the camera manually, you can designate the new area or object as the air-to-ground target point. This will update all steering and weapon release calculations. To do this, left-click PB 1 (CDES) to designate the area/object inside the tracking gate as your target. Then, left-click PB 7 to box TRK and re-lock the camera. The CDES function is particularly useful when you're tracking a moving object, such as a truck or ship — it updates the targeting diamond on the HUD as the target moves.

Line up for an AUTO bombing run.

- Now, you need to fly toward the target. When a target is selected, the *command heading bug* (which normally indicates the heading to your current steer point) shows the heading to your target instead. Maneuver until you've got the command heading bug in the center of your heading scale.

HUD in AUTO bombing mode



- As long as you're in AUTO mode and your steering is correct within 20°, a long, vertical line appears on the HUD. This line, called the *azimuth steering line (ASL)*, originates at the target point and extends straight up. The goal is to maneuver so that this line bisects the waterline ( ) and the velocity vector ( ). It should be exactly vertical, and not slanted.

- Once everything is in alignment, hold your speed, heading and altitude steady, remain level, and follow the WSO's cues that appear at the top of your screen. He'll count down to release for you. You can also tell how long remains by looking at the time-to-release (TREL) reading in the HUD.

Drop the bomb/arm laser.

- When your WSO says "10 seconds to release," get ready to pickle (i.e., ready to press joystick button 2). At around 5 seconds TREL, press and hold the button until the timer reaches zero. Then, use the mouse to select the ARM pushbutton (PB 19) and arm the laser (the text changes to LASE). The bombs will home in on the laser designation.

Note: *If your steering is off by more than 20°, the ASL will disappear and you won't be able to release weapons.*

- If you're making a really low bombing run, you can activate LASE before you release the weapons. At higher altitudes, however, the bombs will have trouble following the laser beam and may weave. In any case, the laser only works at altitudes below 25,000ft — if you're flying higher than this, you can't use it to illuminate targets for laser-guided weapons.

- Watch the Target IR MPD after you drop the bomb(s). The pod LOS cue centers itself on the target, and a TIMPACT time (time-to-impact) will replace TREL in the HUD. If you want to check out the explosion, press F7 just prior to impact to jump to an external camera view.

IMPORTANT! *After detonation, turn off the laser by selecting the LASE pushbutton.*

Acquire a new target.

- In this manner, keep picking out targets of opportunity until you're out of weapons or SAM and AAA sites.

- In this mission you don't have much time to fire on targets in this area before a trio of MiG-29s shows up. When that happens, you'll need to either send someone after them with a Tab message, or take them on yourself. The CAS loadout has 4 AIM-9L Sidewinders by default.

AIRFIELD STRIKE

One mission that best utilizes the F-15E's potential is an air strike against an enemy airfield. Hitting an airfield accomplishes several objectives. The main intent of an air strike is to damage taxiways and runways to an irreparable state. Building a new runway — or repairing an old one, for that matter — is a monumental task. In the interim, the airfield is essentially useless to the enemy. Enemy aircraft that would normally oppose friendly forces or conduct reconnaissance or air strikes against friendly sites are grounded, and possibly even damaged or destroyed during the attack. This greatly hinders the enemy's ability to monitor the battle from a distance.

Secondary effects of destroying an enemy's airfield include the decimation of other tactical targets. Sometimes, one striking F-15E will be tasked with taking out the taxiway and/or runway while the other attacks the control tower. Fuel tanks, radar facilities, hangars and grounded aircraft often make other ripe auxiliary targets once the main task is finished.

The Strike Eagle has a special weapon designed specifically for runway destruction. The BLU-107 strikes the ground without detonating, then burrows its way down as far as five to ten feet below the surface before the fuse fires. The underground explosion is much more effective than a simple surface explosion, and the destruction greater. To strike other large airfield targets, the WSO will usually select a Mk 82 or other Mk-series bomb. Guided missiles are normally reserved for situations in which certain targets are not to be hit (e.g., friendly hostages).

SAMs, AAA and enemy aircraft pose the biggest threats to the F-15E during an airfield strike. During Desert Shield and Desert Storm, for instance, two of the three Eagles lost were shot down by enemy missiles and AAA fire. In order to minimize casualties, SEAD flights (Suppression of Enemy Air Defense) are often sent in ahead of a strike to take out dangerous ground-to-air weapons.

You'll probably want to check out the Briefing map before takeoff. If SAM or AAA threats are probable, you'll want to make a low-altitude bombing run. If the target is essentially undefended, or if a SEAD flight is preceding you, you can afford to make a high-altitude approach. One threat inherent to airfield attacks is enemy aircraft — be prepared to face fire from both above and below.

Playtester Tips

- Two default runway loadouts exist — Runway and Runway 2. You can either fly with one of these, or alter Runway 2 to match one of our playtester's favorite three loadouts for airfield strikes, listed below:
  - AN/AAQ-13 and -14 LANTIRN pods with 6 BLU-107s for the runway
  - 2 AIM-120s with 6 BSU-49s or CBU-87s for small secondary targets
  - 2 AIM-9s with 1 BSU-50 on centerline pod (for hangars, etc.)
- If the airfield is relatively close to base, you can exchange the external fuel tanks for another pair of bombs (such as BSU-50s). This provides enough firepower for you to single-handedly take out an airfield.
- If SAMs are mentioned in the mission briefing, you may want to take a few Mavericks along in case you face them, or a bomb powerful enough to vaporize a group of SAM units.
- On your approach, a SEAD package should precede you in order to suppress or jam enemy SAMs. Sometimes, however, a few go unnoticed, and you're forced to deal with them on your own. If you go in low and fast, you can often avoid being detected by a SAM radar. In this case, you should try to hit what you can in one or two passes.
- A flight involving an airfield attack usually consists of six aircraft. Pairs of planes often have the same assignment — two attacking the runway, two attacking the control tower, etc. Your flight will usually be tasked with approximately four primaries — the runway, taxiway and a couple of other smaller tactical objects.
- Make sure you have A/G (air-to-ground) master mode active prior to reaching the target area. One waypoint ahead of the target point is a good place to start preparing your strike. Quickly jump to your TSD to find your target spots — they're marked with green triangles. Then, zoom your radar out to 80km using the A/G Radar MPD pushbuttons.

- Once you're within 30nm of the target, tell your wingman to go ahead and attack (1, 8, 1. or 1, 8, 3) After you get there, you're not going to want to worry with issuing him commands, so it's best to set him free now.
- During an airfield attack, your assignment is usually one of the runways. Some airfields will have several different runways, and different aircraft may be tasked with the same runway. The best thing to do when you arrive at the target area is make a pass over the runway to align your plane correctly. If ground threats exist, make sure you're low, at least under 500 feet of altitude.
- By attacking the length of the runway instead of the width, you can drop successive bombs and score several hits on a single pass.
- Only certain sections of the runway need to be destroyed to render it useless. To see exactly where you must hit the runway, look for the green triangles on your mission map before you take off. (For the Single Airfield Attack mission, you can open the mission in the Mission Builder and view the target areas.)
- Once other aircraft in your flight have accomplished their mission at the airfield, they won't volunteer to help you. However, you can ask for help from them as long as you haven't sent them home, by relaying a "Cover Me!" message. So, make sure you and your wingman have enough ordnance to take out the targets you've been assigned.
- Try and call in SEAD support if it was mentioned in your briefing. Do this before you arrive at the target area — it takes a while for the SEAD flight to arrive. If you're willing to wait, this flight can significantly reduce the amount of surface-to-air resistance you'll face.

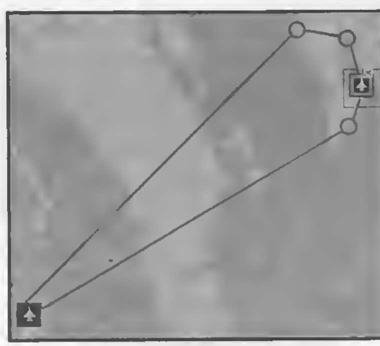
Example: Airfield Attack

Mission Parameters	
Flights (Callsign)	4 x F-15E (Edsel)
Mission	Airfield Strike
Recommended Loadout	Runway 2, but replace one rack of Mk 20s with 6 BLU-107 Durandals
Environment/Time	Clear/1800

Mission Intro
With a single, quick offensive movement, enemy forces have overtaken the Al Ahsa airfield and are preparing to use it as a base for transporting supplies and troops into the area. To interrupt their plans, you are to destroy the runway and render it inoperable.

Success	
Moderate	Destroy runway; 65% friendly aircraft survive
Perfect	Destroy runway; no friendly aircraft losses

This mission will give you plenty of opportunities to practice your medium- to low-altitude bombing techniques with unguided weapons. As your TEWS will eventually indicate, quite a few ground threats lurk around the perimeter of the base. You don't have to destroy any of them, however, to win the mission.



Make your approach.

- Using the Jump function (Shift J) will take you to your target area. You've got to steer to the right and travel through one more steer point before you reach the airbase, but don't jump a second time. If you do, you'll end up right in front of your own landing strip.

Set up weapons.

- While you're flying to the next steer point, set up your weapons. This time, select CDIP bombing mode and the BLU-107 pylon.
- You can ripple-fire your BLU-107s (release several in succession) by setting the quantity to 2 bombs (PB 3 and 4), selecting RP MPL (PB 8) and changing the drop interval to 170 (PB 12 and 13). This will drop two bombs at a 170ft interval, leaving you four more for two additional runs.
- After setting up your weapons, replace the A/G Arm page with the Target IR page — this will allow you to see a FLIR image of whatever you have targeted.
- Go ahead and set your wingman and accompanying flight free at this point. They'll commence their attack run, and you can start yours.

Map the target.

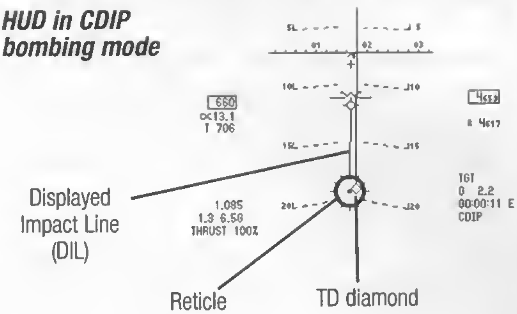
- Don't bother creating an HRM map until after you pass Nav 3A — you won't have the airbase in your radar sights until then. Picking out the airstrip isn't too difficult. Zoom the map in to 10km, then make a 1.3km map over the specks in the A/G Radar MPD, and you're set. At about 8nm out from the airstrip, you'll easily be able to target a point on the runway.
- You're going to be aligned with the runway for the most part, but you are slightly to the right of the airbase. Drift left, then straighten out so that your aircraft is traveling the length of the runway.
- You must destroy several spots on a runway to render it useless. If you're going to try to drop all your bombs in one pass, target the end of the runway that is closest to you. That way, if the first few bombs fall long, they'll still land on the runway.

Line up for the bombing run.

- Since the BLU-107s you're carrying penetrate the ground before exploding, you can stay fairly low without fear of getting caught in the blast. A low approach (around 200ft) is especially preferable in this mission because of the number of SAM and AAA sites. You won't face much SAM fire this low, although AAA can still hit you.
- Hand-in-hand with low altitude goes high speed — afterburn your way past the airfield at 600 knots as you drop your bombs. At that speed, chances are that AAA won't even know you're there until after you've dropped your bombs.

Make a CDIP bombing run.

HUD in CDIP bombing mode



- The *reticle* indicates where the bomb will impact, given current flight parameters. The *displayed impact line (DIL)* represents the bomb's flight path. The object is to place the reticle over the *target designator (TD) diamond*. (If you haven't designated a target, you can visually aim for a spot on the ground.)
- The faster you're traveling, the farther your bomb travels forward prior to impact, and thus the closer the reticle will be to the center of the HUD. (Your momentum carries the bomb forward.) Therefore, high airspeed means that you don't have to dive steeply to correctly position the reticle.
- In CDIP bombing mode, you won't get any WSO release cues. When you have the reticle positioned directly over the TD diamond, release the bomb. If you wait too long, you'll be too low, and your G-load will be extremely high when you pull up.
- Note that you really don't have to dive in this bombing mode if you're using low-altitude bombs. For the Mk-series bombs, however, you'll probably want to give yourself enough altitude to make a 20° dive to keep the CDIP reticle visible on your HUD.
- CDIP bombing mode gives you direct control over weapon release and lets you release a bomb without previously designating a target point.

Watch out for scrambled aircraft.

- In this mission, three MiG-21s may at some point scramble from the base. This is the enemy's normal reaction when you're threatening an airbase, and it's always a good idea in these cases to assign the auxiliary flight (if one exists) to incoming bandits while you concentrate on bombing. And since all you need to hit in this mission is the runway itself, you can send your wingman after the most dangerous anti-aircraft threats.

ANTI-SHIP

Occasionally, but not often, F-15Es are tasked with taking out ships. An anti-ship attack is like an ordinary ground strike, although targets at sea can be harder to find than targets on land. However, most ships move relatively slowly, and for the most part, aren't heavily armed for anti-air attacks.

The most difficult aspect of an anti-ship mission is trying to find an isolated group of ships in a featureless ocean. There are no roads, so no routes of travel can be easily identified. Inside 20nm, vessels are fairly easy to spot with the radar. Beyond that, detecting a small convoy of ships is difficult over open water. Most of the time, groups of ships are discovered by reconnaissance flights or other aircraft prior to calling in strike aircraft.

Nap-of-the-earth (nap-of-the-sea?) flight is the preferred approach once a ship target has been identified, although oceans and seas don't offer much in the way of terrain protection. However, the lower the strike aircraft, the closer the flight can come to the ship before being detected. Even if a ship does spot an inbound attack flight with its powerful on-ship radars, an enemy's call for help won't quickly bring in any opposing aircraft — unless the ship happens to be a carrier.

In the game, most of the anti-ship missions you'll face involve protecting large, friendly ships from attacks by smaller gunboats. Or you may be tasked with taking out a group of ships on their way to a tactical location. Because ships present such a distinct target against water, they make ideal targets for guided munitions of all types. Mavericks won't do much damage to ships, but larger and more powerful weapons will often do the job in a single pass. If the bomb is large enough, one hit may even score collateral damage on a second nearby ship.

Playtester Tips

- Anti-ship missions can be a lot of fun if you're up for the challenge of finding a target. To find a ship, activate your A/G master mode and look at the A/G Radar MPD. Press the IMGT pushbutton to change the radar mode — this mode shows moving objects.
- Ninety percent of the time, you're looking for small boats, not big ones.
- You could fail the mission if you destroy the wrong boat. Make a visual ID using the Target IR MPD (if you have the AN/AAQ-14 loaded) before firing.

- Use guided missiles in anti-ship missions! Ships are tiny compared to airfields, bases and other large targets, and your dumb bombs aren't going to do much damage unless you score a direct hit. At least over land, you've got a chance to hit something else nearby.
- In the campaign, you might consider unloading dumb bombs on a ship if your weapons stores are running low and you want to conserve your guided munitions. Since the targets are lightly defended, you can afford to get closer on your approach.
- Most bombs must be dropped from high altitudes. If you drop a powerful bomb while flying low, it's likely to detonate right below your aircraft. Some bombs, such as the BSU-49 and BSU-50, have built-in drag parachutes that allow you to fly slightly ahead of the detonation.
- Large ships tend to fire SA missiles at you, while small ships fire AAA.
- On an anti-ship approach, tell your wingman to engage targets of opportunity when you get close to the target area.
- Don't use Mavericks against something as tough as ships, since they won't do enough damage.
- To make an unguided bomb run against a ship, come in low. (For guided munitions, a medium-altitude approach is best.) At about 35 to 40nm out, you can detect and target a ship with your radar. Once you find one, drop your altitude to under 2000 feet and turn toward the ship. (Make sure it's the designated target.) Once the ship is within visual range (about 10nm or so), angle down a bit as you release your bomb.
- Keep in mind that ships are moving targets. Lead your dumb weapons slightly ahead of the boat in the direction it is traveling. The lower your altitude, the less lead you'll need.
- Although boats may be difficult to hit, they're not very good at evasive action.

Example: Pirate Hunt

Mission Parameters	
Flights (Callsign)	2 x F-15E (Dodge)
Mission	Anti-Ship
Recommended Loadout	Smart Bomb, but replace AMRAAMS with GBU-10Gs
Environment/Time	Clear/0140

Mission Intro
OSA patrol boats are sailing in the Gulf, and their tanking and freighter vessels have been spotted by friendly intelligence. You are to lead a nighttime attack run to sink the refueling vessels.

Success	
Moderate	Destroy freighter or tanker; 65% friendly aircraft survive
Perfect	Destroy freighter and tanker; no friendly aircraft losses

Unlike most of the other Single missions, this one takes place at night. From an MPD standpoint, this won't make much difference. Visually, you might find the FLIR imagery on the HUD slightly disconcerting until you get used to it. If you have trouble distinguishing the HUD readouts from the background, cycle through to a different HUD display color by pressing [H].

Arm your weapons.

- Hopefully you've loaded some precision-guided bombs on this mission. If not, you might consider escaping out of the mission and re-arming your plane with a few GBU-10Es or -10Gs. Hitting ships with dumb bombs is not impossible, but it's difficult. Guided munitions make the job significantly easier.
- You can select any of the three bombing modes, but level Auto bombing is preferable over CDIP or Auto Loft bombing, especially if you're using guided bombs. (CDIP bombing is discussed on p. 166, and AUTO bombing on p. 167.)
- The briefing recommends a high-altitude approach, but altitude doesn't figure tremendously into this mission. The biggest reason for flying at 8000 to 10,000ft is that your laser-guided weapons have more time to home in on the target.

Locate the ships.

- Finding the general location of the fleet isn't too difficult. Your biggest problem is going to be finding the correct target ships. The difficulty of this task is intensified because this is a nighttime mission.
- Jump to the ingress point (Shift J), fly through the next steer point, then make the smallest HRM map you can around the specks that appear on your A/G radar.
- Six small OSA gunboats are trolling slightly ahead of the freighter and tanker, but the two large target ships are sailing side-by-side.
- The AAA fire you might face isn't nearly as intense as ground-based AAA. The gunboats won't fire on you very often, and if you're flying below 500 feet, there's little chance that they'll bother you at all.
- When you find the large ships, target one of them. If they're within visual range, and if you're flying at a low altitude, it's easiest to left-click on one of them in the HUD. The closer to the center of the ship you place the targeting diamond, the better. At higher altitudes, you'll want to use a .67km HRM map and the Target IR MPD to target one of them.

Make a bombing run.

- A single GBU-10/-10E hit won't take out either the freighter or tanker vessel. You'll need to make two separate passes to sink both ships.
- Line up each run so that you overfly the ship length-wise.
- Be sure you've got Auto or CDIP mode active, and that the CDES pushbutton is boxed — this will track a moving target in the Target IR MPD.
- At about 20 seconds until release, it helps to dip the nose slightly to make sure your targeting diamond is centered on the ship (make a visual check in the HUD). If necessary, pause the game and re-target the ship visually. Then, resume level flight and drop the bomb on the WSO's cue.
- With laser-guided weapons, remember to give yourself enough altitude. If you drop a GBU-10 from 1000 feet, you don't have enough time to switch on the laser, and the weapon doesn't have time to track the beam and alter its course accordingly. Switching the laser on before release doesn't help — the weapon will expend all its energy too early and fall short.


Iran
International boundary
Province (ostān) boundary
National capital
Province (ostān) capital
Railroad
Road
250 Kilometers
Caspian Sea
Persian Gulf
IRAQ
KUWAIT
SAUDI ARABIA
BAHRAIN
QATAR
Baghdad
Kuwait
Manama
Doha
Dubai
Abu Dhabi
Tabrīz
Āstārā
Rasht
Mahābād
Kirkuk
Sanandaj
Qazvīn
Tehrān
Qom
Semnān
Kāshān
Hamadān
Arāk
Khorramābād
Īlām
Dezfūl
Eşfahān
Shahr-e Kord
Ahvāz
An Nāşirīyah
Al Başrah
Umm Qaşr
Ābādān
Khorramshahr
Bandar-e Khomeyni
Yāsūj
Shīrāz
Bandar-e Būshehr
Kangān
Bandar-e Lengeh
Yazd
Euphrates
Tigris
Shatt al Arab
KORDESTĀN
ZANJĀN
GĪLĀN
MĀZANDARĀN
TEHRĀN
HAMADĀN
MARKAZĪ
LORESTĀN
ĪLĀM
EŞFAHĀN
KHŪZESTĀN
CHAHĀR MAHĀL VA BAKHTĪARĪ
BŪSHEHR
FĀRS
YAZD
alignment approximate

CAMPAIGNS


TURKMENISTAN
Gyzylarbat
UZBEK
Chardzhou
Ashgabat
Bojnurd
Tejen
Mary
Mashhad
Sarakhs
Saragt
railroad u/c
KHORĀSĀN
Gushgy
Kavir e Namak
Herāt
Birjand
AFGHANISTAN
Farāh
Kermān
Bām
Zāhedān
PAKISTAN
Nok Kundi
Bazman
SĪSTĀN VA BALŪCHESTĀN
Jāsk

IRAQ CAMPAIGN

The *Jane's F-15* missions emulate, as closely as possible, the missions that the U.S. Air Force flew during the Gulf War. Primarily these missions were air-to-ground strikes, over enemy territory riddled with SAM and AAA, quite often at night. The F-15E pilots had to adapt to a different climate, a different culture and a radically altered sleep schedule — and yet they were able to admirably perform their duty under grueling circumstances. The Iraq campaign is your glimpse into the months they spent serving in the Middle East.

It would be largely useless to describe the campaign flown over Iraq on a mission-by-mission basis, since it is flown over roughly the same area (with a map available in every briefing) with each mission affecting the SAM and AAA found in subsequent missions. For specifics on how best to fly Iraqi campaign missions, see **Mission Types**, pp. 46-97.

While it would take a shelf of books to dissect the political firestorm that led up to the situation in the Gulf, the *Timeline* and *Key Players* below might help bring into focus the sequence of events that led to the missions available in the *F-15* Iraq campaign.

Desert Storm Timeline

1990

May - July Saddam Hussein, President of Iraq, claims oil overproduction by Kuwait and the United Arab Emirates is "economic warfare" aimed at Iraq. He also claims that Kuwait has "stolen" oil from fields that do not belong to Kuwait and warns of military reprisals.

Iraq begins military buildup against Kuwait.

2 August Iraq invades Kuwait, and gains control of the oil fields.

The United Nations demands that Hussein withdraw his forces from Kuwait.

6 August The U.N. imposes economic sanctions against Iraq.

7 August King Fahd of Saudi Arabia requests U.S. military assistance to forestall a possible Iraqi attack.

8 August Hussein announces the annexation of Kuwait.

9 August The 82nd Airborne and several fighter squadrons arrive in the Middle East.

The U.N. declares that Hussein's annexation of Kuwait is invalid.

10 August Iraq announces that there is now a "jihad" — holy war — against the U.S. and Israel.

12 August All naval shipments of Iraqi oil are interdicted.

22 August The United States calls up military reserves in preparation for war.

25 August Military interdiction against Iraq is formally authorized by the United Nations.

28 August Saddam Hussein, ignoring the stance of the U.N., announces that Kuwait is Iraq's 19th province, and that it is now to be called al-Kadhima.

14 September Britain and France send 10,000 troops to the Middle East.

8 November President Bush orders more troops to the Gulf area to provide an "offensive option" to the U.S. forces currently deployed there.

29 November U.N. Security Council authorizes military force if Iraq refuses to withdraw from Kuwait by midnight, 15 January, 1991.

Hussein rejects all U.N. resolutions.

1991

3 January The Department of Defense curtails war reporting by media.

9 January Talks in Geneva between U.S. Secretary of State Baker and Iraqi Foreign Minister Aziz end with no progress made.

12 January Congress grants President Bush authority to use U.S. troops in offensive operations overseas.

15 January Iraqi troops make no move to be out of Kuwait by the deadline set by U.N. Resolution 678.

16 January The U.S. declares publicly, "The liberation of Kuwait has begun ...."

17 January	Operation Desert Storm commences at 0300 Baghdad time.
	U.S. bombers begin their attacks on Baghdad, Kuwait and Iraq.
17 January	Iraq launches first Scud missile.
19 January	First Scud missiles are launched at Israel.
22 January	Hussein orders the firing of Kuwaiti oil wells.
25 January	Iraq begins assaults on the environment by pumping millions of gallons of crude oil into Gulf.
30 January	Iraq and Coalition forces meet in the first conclusive ground battle in Khafji, Saudi Arabia.
1 February	Secretary of Defense Cheney makes it clear that the U.S. will retaliate with deadly force if Iraq uses chemical or unconventional weapons.
6 February	King Hussein of Jordon announces support of Iraq, citing American bombardment as cause.
17 February	Tariq Aziz begins talks in Moscow to discuss possible negotiated peace.
19 February	President Bush refuses Soviet-Iraqi peace plan.
22 February	President Bush announces that Hussein must withdraw his troops from Kuwait to avoid ground war.
24 February	Ground campaign begins in Iraq and Kuwait.
26 February	Iraq announces withdrawal from Kuwait.
26 February	Kuwaiti leaders regain control of Kuwait City.
27 February	Coalition forces enter Kuwait City.
	U.S. 1st Armored Division confronts the Iraqi Republican Guard in the battle of Medina Ridge.
	Kuwait is declared "liberated" and a cease fire is announced.
3 March	Iraq formally accepts the terms of the cease fire.
8 March	First U.S. troops return stateside.

Key Players

USA

George Bush. President of the United States, and major decision-maker during the Gulf War

Dan Quayle. Vice President of the United States

Colin Powell. U.S. General, Chairman of Joint Chiefs of Staff, military/presidential liaison

Norman Schwarzkopf. U.S. General, CENTCOM Commander

Jim Baker. Secretary of State

Richard Cheney. Secretary of Defense

Brent Scowcroft. National Security Advisor

Iraq

Saddam Hussein. President

Tariq Aziz. Foreign Minister

Israel

Yitzhak Shamir. Prime Minister

Moshe Arens. Defense Minister

Kuwait

Sheikh Jaber al-Ahmed al-Sabah. Emir of Kuwait

Saudi Arabia

Fahd. King of Saudi Arabia

Soviet Union

Mikhail Gorbachev. President

IRAN CAMPAIGN

The Iranian Campaign is designed around a "what if" scenario extrapolated from current circumstances. The premise is that Iran tries to "persuade" its neighbors into forming alliances that are distinctly anti-Western in nature. The Western countries, the U.S. in particular, try to keep this Middle Eastern Bloc from forming.

Unlike the U.S./Iraq war campaign, it is not based on historical fact, and is thus more flexible in outcome. There is, however, a realism to the way the missions will be presented.

There is no way to provide a breakdown of every mission you'll ever encounter — there are hundreds if not thousands that you'll encounter as you play and replay the campaign. However, they can be divided into eight military "situations."

As in real life, most of these situations can develop simultaneously, which means that your squadron must tackle a variety of the different missions types, one after another. (You won't necessarily finish dealing with one situation before you encounter another one, and not all the possible situations will develop into assignments for your squadron.) However — barring the end of the war — eventually each situation you deal with will be resolved in either victory or failure.

The damage done during each mission will affect subsequent missions that address the same situation. For instance, if you are sent to destroy a supply depot, and destroy 60% of the storage facilities, you may get sent back to the same depot, but it will be easier, since most of the storage facilities were destroyed in your first pass. It's just a matter of going back and completing the job.

Of course, the results of some situations will have more impact than others. For instance, the *Invasion Buildup* and *UAE Invasion* are obviously critical situations, and can affect the outcome of the entire military action. The *Offshore Oil Field Attack*, however, has much less impact on the outcome of the campaign.

Below (after the Campaign Introduction) is a summary of each military Situation, and the most common results of a successful or unsuccessful outcome.

INTRODUCTION

Over the last five years, Iran has become a major military player within the Persian Gulf region. The size of Iran's military forces have increased and modernized at a faster pace than any other Gulf State. By purchasing aircraft from Russia and China and upgrading existing aircraft, the Iranian Air Force now represents a credible air threat for the first time since the overthrow of the Shah. Iran has also continued to build up their naval power with continued purchases of missile boats and other vessels. The army has benefited from both purchases from abroad and successful domestic programs started in the early nineties. Perhaps more troubling is the large number of former eastern bloc 'advisers' employed as instructors in aggressive, realistic training programs throughout the entire Iranian armed forces. Iran continues to flex its military muscle on a regular basis by conducting huge military exercises within the Gulf; all of these exercises have been viewed by experts as primarily offensive in nature. However, the moderate government of Iran has made huge strides easing the distrust of the western nations with particular attention being paid to thawing U.S.-Iran relations. With mounting pressure to spend more money on domestic programs, it becomes easier for the U.S. Congress to take Iranian goodwill gestures at face value. A strong moderate Iran is seen by some as the ultimate counter to Iraq under Saddam.

Following the Gulf War, the United States government continued the downsizing of its military which began with the collapse of the former Soviet Union. The U.S. government has mandated a smaller, smarter military; but since continuing budget cuts have caused delays in several major weapons programs, it is now only smaller. The Air Force is particularly hard hit by cutbacks with both the F-22 and Joint Strike Fighter programs being greatly stretched out in an effort to save short term costs. A further round of downsizing leads to a significant reduction of active duty military forces throughout the world. The ability of the U.S. military to be able to fight two regional conflicts simultaneously is now highly unlikely.

U.S. military forces based in the Gulf were reduced during these downsizings.

As the year 2001 ends, the Middle East is again becoming a highly unstable region despite the easing of tensions between Iran and the west. The breakdown in the Middle Eastern peace process has fueled an increase in the anti-western sentiment that has simmered throughout the region for years. Some of the United States closest allies in the region are finding it politically difficult to allow the United States to base military forces in their countries. Many of the nations once friendly to the west have started questioning the role that the U.S. military

is continuing to play in the region. Both Turkey and Jordan, now ruled by more conservative governments, no longer allow United States military units to operate from their respective countries.

Among the Gulf States, Saudi Arabia has undergone significant internal upheaval. Following the death of King Fahd, the ruling al-Saud family appointed a new, more conservative king. The new king, while friendly to the United States, has greatly reduced the foreign military presence in Saudi Arabia after heavy pressure from conservative Islamic religious leaders.

As a result of these events, the number of U.S. military forces based in the Persian Gulf region are further reduced.

On January 3rd, 2002, trouble comes to the world, but it is not in the Middle East. Halfway around the world, the Korean peninsula is again a hot spot. An incident has occurred between North and South Korea that is rapidly escalating towards war. The attention of the United Nations Security Council is drawn to the Far East as large numbers of U.S. and allied nations rush additional military forces to the region.

The U.S. military forces in the Gulf are further reduced to cope with this new threat.

Things move quickly after that ...

25 January, 2002

The moderate president of Iran is assassinated by a brutal rocket propelled grenade attack in the streets of Tehran. Almost immediately, ultra-conservative clerics announce that they again are the ruling power in Iran, calling the assassination "the will of God." The policies of moderation are swept aside in the second Islamic revolution to grip the nation in thirty years. Most of the Iranian government is replaced by hard line clerics who form a new Revolutionary Council. In a change from the first revolution, the military strongly supports the new government. Anti-U.S. sentiment within Iran quickly grows stronger than ever, while the U.S. military presence in the Gulf region is at its lowest level in decades.

2 February, 2002

The Iranian government denounces the presence of the United States military in the region. The Iranian government claims that the U.S. government is trying to provoke a war with Iran. Iran starts an aggressive diplomatic campaign to pressure its neighbors to expel foreign military "defilers" from their countries. The new government proclaims the Iranian military to be "the sword of God," and vows to remove all of the western "infidels" from their holy lands once and for all, by force if necessary. Fearful of Iranian ambitions, the tiny Kingdom of Bahrain

invites a token USAF expeditionary wing to operate from their military airbase of Shaikh Isa. Being heavily committed in the Far East, the request could not come at a worse time for the USAF. A small number of F-15C's, F-16's and F-15E Strike Eagles are placed on alert for possible deployment to Gulf.

20 February, 2002

Under the cover of what Iran had previously announced as a major military exercise lasting several days throughout the Gulf, Iran suddenly moves several thousand troops onto the disputed islands of Tunb, Abu Musa, and Sirri. While the U.S. strongly objects, the United Arab Emirates, which also claims the islands, decides to attempt diplomatic negotiations with Iran. The UAE declines an offer by the U.S. to deploy U.S. Marines to the Emirates, fearing to provoke hostile reaction. Also fearful of Iranian ambition, Kuwait allows a small number of Marine F/A-18 Hornet and Navy EA-6B Prowler aircraft to operate from bases within the Kingdom.

4 March, 2002

A U.S. flagged oil tanker is sunk in the Strait of Hormuz by Iranian missile boats; 16 of the crew are killed. Iran claims that the ship was spying in Iranian territorial waters. The United Nations Security Consul is unable to reach a consensus on a draft resolution condemning the attack, thanks to the objections of Russia, China, and other anti-western member states.

7 March, 2002

Two tankers trying to enter the Strait of Hormuz are are damaged by mines. It is discovered that Iran has heavily mined the waterway. New intelligence indicates over 5,000 mines have been deployed. The Straight of Hormuz has been closed to western shipping. The world's oil markets are in turmoil.

All U.S. military forces in the region are placed on the highest state of alert. The U.S.A.F air expeditionary wing is deployed to Bahrain. Your squadron has been attached to that wing.

The majority of U.S. military forces are committed in the Far East. There are currently no aircraft carriers and few land based strike aircraft in the Persian Gulf area. There is little chance that additional forces will become available in the near future. Your squadron represents the majority of airborne striking power available to CENTCOM should air strikes against Iran become necessary. It is imperative that you succeed with any missions that you are tasked with. Failure to hold the line will most likely result in a humiliating withdrawal of all U.S. forces before any additional offensive power can be brought into the theater.

MILITARY SITUATIONS

For specifics on how best to fly different types of campaign missions, please see **Mission Types**, pp. 46-97.

The remainder of this section outlines the overall situations that are the driving forces in the Iraqi Campaign. A brief summary of the circumstances which lead up to the deployment of your squadron is followed by the general types of missions you can expect to face, and the probable results of success or failure.

Offshore Oil Field Attack

During the past year, religious leaders within Saudi Arabia have been putting pressure on the king to further reduce the foreign military presence within the kingdom. Air strikes originating within Iran have begun against offshore Saudi Arabian oil fields. The U.S. State department believes that these attacks are being used as scare tactics to persuade the Saudi king to act on Iranian demands. Saudi Arabia represents a vital strategic military and economic interest to the United States, and remains one of the few friendly nations in the region.

The Iranian hit and run attacks against Saudi offshore oil platforms must be stopped. First, the raiders have to be neutralized, then their base of attack must be destroyed.

Completing this aspect of the campaign successfully means that Saudi/U.S. relations will solidify. Failure means that Saudi/U.S. relations will deteriorate.

Interdiction

Iran is moving a considerable amount of supplies, military equipment and troops from the interior of Iran to the port city of Bandar Abbas, located near the Straight of Hormuz. The continued build-up of military forces into this region could be the prelude to wider military aggression by Iran.

You must attack supply lines, airstrips and storage facilities.

Success means that the situation in Korea can receive the military's full attention while only a few squadrons keep Iran's crippled military forces in line. Failure means that your military forces will be dangerously split while both Korea and Iran gear up for all-out offenses.

Deep Strike/ Chemical Weapons Factory

Iran has re-established chemical weapons research and production complexes. Now they are operating around the clock, and indications are that the large quantities of weapons required for the "Doomsday" plan will soon be ready. Most of the completed weapons are being stockpiled at the main manufacturing plant. It is possible that they will launch an attack against U.S. forces and their local allies, and there is also growing concern that Israel will take matters into its own hands and launch preemptive strikes. This must be prevented at all costs.

Your squadron will be sent into central Iran, striking first at air defense sites.

Success will bring further U.S. support and forestall any "final strike" attempts from Iran. Failure will lead to a deterioration of Middle Eastern support for the U.S., and the creation of Iranian alliances with our allies who grow afraid of their aggressive neighbor.

Intercept Anti-Shipping Fighters

Iran has adopted a policy which declares that all western-flagged vessels will be considered legitimate military targets, regardless of non-military or commercial status. Aside from concerns of ethics and piracy, this is politically and financially unfeasible for the Western nations.

You are tasked to protect commercial ships as they head for ports of safety, and to attack any active/aggressive anti-ship cruise missile sites and facilities.

Success will mean increased credibility for the United States in the Middle East. Failure will doubtlessly lead to increased Iranian troubles.

Strikes Against Iranian Leaders

There has been a series of meetings between very high ranking members of the Iranian military and Revolutionary Council. These meetings are determining the nature of future military offensives targeting U.S. and allied military forces.

You are tasked with attack of nearby defenses, leadership headquarters, and airfields near the area.

Success cripples the leadership of the opposition and forestalls any aggressive acts by Iran. Failure leads to a weakened confidence in the U.S. and heightened civilian losses in Kuwait City due to Iranian retaliatory Scud launches.

Defense of Bahrain

A direct attack on U.S. forces is imminent. Increasingly hostile rhetoric from Tehran warns that the "Sword of God" will soon destroy the "western devils." Your base in Bahrain is likely a prime target for such an attack.

You are tasked to protect the military airbase at Shaikh Isa. As a precaution, the Combat Air Patrols around Bahrain will be augmented by aircraft from your squadron.

Success gives U.S. forces an undeniable position of power. Failure leads to the probable expulsion of U.S. forces in the area.

Invasion Buildup

Iran and UAE have broken off all discussions in regard to claims to the disputed islands. A significant increase in military air and sea transports to the islands has been noted. Additional ground units appear to have been mobilized and are massing at several staging areas along the southern Iranian coast. The close proximity of Iran to the UAE would make it extremely difficult, if not impossible, for the limited CENTCOM forces to halt a full scale Iranian invasion once it had started. It is imperative to impede the flow of supplies and weapons into the area in order to discourage future Iranian offensive actions.

Your squadron will be tasked against supply lines and/or airfields and storage facilities on the islands.

Success will hamper, perhaps permanently, the Iraqi aggression. Failure invites a large-scale Iranian offensive. UAE must prepare for defense of their nation.

UAE Invasion

Iran invades the United Arab Emirates. A spokesman for the ruling Revolutionary Council calls the action "the beginning of the cleansing" and claims the invasion is in response to a request from unnamed religious leaders within the Emirates, citing the "western corruption" of their leaders. In what is almost certainly not a coincidence, the North Korean military launch a renewed offensive against the embattled South mere hours after the Iranian strike. A quick and decisive win is desperately needed in the Gulf region to allow the military to focus on the Far East. This could very well be the final battle.

You must see to it that Iranian armored divisions not be allowed to land.

Victory is a stunning blow against the Iranian forces. Failure results in the surrender of the UAE military and the possible forging of a political "shotgun" alliance between the UAE and Iran.

POSSIBLE OUTCOMES

Success or failure of your missions affects the overall military effort. This, in turn, has an impact on the local political climate, the future of relations between the U.S. and the Middle East, and lastly, your continuing career as a fighter pilot.

Outcome A

Sudden internal upheaval in Iran causes the Gulf States to heave a collective sigh of relief. The immediate threat to the region is over, but an unstable Iran will always be a cause for concern. With events of the past weeks fresh in their minds and the future unclear, new joint defense initiatives are being planned. Defense spending by all members of the Gulf Cooperation Council is now expected to sharply increase. Based in large part on the successes of American equipment and tactics, U.S. defense manufacturers are expected to benefit the most during the coming shopping spree.

With the crisis in the Gulf now over, most recently called-up reserve units go to the Far East, arriving just in time to help enforce another U.N. sponsored cease fire between the Koreas. Your squadron is finally relieved from the Gulf and you return home to a hero's welcome. During a personal visit to welcome you home, the President calls your squadron "some of the few that stood firm against many."

Congratulations! You've won!

Outcome B

The situation in the Gulf seems to have reached a stalemate. Neither Iran nor CENTCOM appears to be able to gain the upper hand in the region. Russian diplomats negotiate a temporary cease fire, and Iran agrees to allow non-western flagged vessels into the Gulf. Talks between Iran and the members of the Gulf Cooperation Council begin, but progress is slow.

Your squadron moves to the Saudi base at Al Kharj where you remain on alert in case the cease fire is broken. As part of the cease-fire agreement, U.S. warplanes are strictly prohibited from flying within 100 nautical miles of Iran. Meanwhile, satellite imagery indicates that Iran is receiving arms shipments from Russia. The cease fire leaves CENTCOM powerless to take any action.

There are rumors that Iran is concentrating on a chemical weapons program. Other nations are unable to do more than issue public condemnations. The real wildcard now is Israel, which has begun hinting that it may be forced to take military action "to preserve its future."

The cycle of aggression seems destined to repeat itself in the very near future ...

Outcome C

Following the occupation of the United Arab Emirates by Iran and the failure of the Saudi counterattack, diplomatic talks hosted by Iran have apparently put an end to the bloodshed. Significantly, the United States was excluded from these talks.

The Gulf Cooperation Council has agreed to the Iranian terms, with only Kuwait dissenting. The Saudi Arabian government has formally requested that all CENTCOM forces leave the country as quickly as possible. Similar requests have come from the other Gulf states except Kuwait. However, apparently fearful of antagonizing Iran, the Kuwaitis did turn down a request by the U.S. State Department to allow CENTCOM forces to relocate there.

On a personal note, your life loses all meaning, spiraling downward until the world loses sight of you entirely.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MISSION PREP AND INGRESS/EGRESS

The theories behind successful air combat, both air-to-air and air-to-ground, are essentially the same regardless of whether you are flying an actual, combat-ready F-15E or *Jane's F-15*. The better you understand the fundamentals of combat missions, the better you are in either a real or virtual cockpit.

The following excerpts are taken from the Air Force tactical combat training document, *Multi-Command Manual 3-3*. Commonly known as the "Dash-3," this guide is an integral part of every F-15E pilot's training, and the information contained within it is vital to succeeding in warfare. These particular sections discuss aspects of mission preparation and air-to-air combat. For excerpts dealing with air-to-ground warfare, see **Air-to-Ground Combat**, p. 164.

All material in the remainder of this chapter appears thanks to the United States Air Force (ACCM/PACAFW USAF EW 3-3, Volume XVII, published 1 June 1994).

3-3 EXCERPTS: MISSION PREPARATION

Introduction

Mission preparation is a key to success in training and combat. The success of all that follows (briefing, execution, and debriefing) is directly related to the amount and quality of preparation. First. determine mission objectives in terms of the desired improvement in measurable combat capability and related basic aircrew skills. Second, individually prepare yourself for the mission. Finally, decide how to brief and execute the mission. Mission preparation is the foundation of successful fighter operations. This chapter addresses several planning considerations.

Establishing Priorities And Situational Awareness

Task Prioritization. During the heat of any mission, there are occasions when everything cannot be done in the available time. This requires prioritizing the tasks.

Fundamental Tasks. The fundamental tasks are:

1. Maintain aircraft control.
2. Do not hit the ground or anything attached to it.
3. Do not hit anything in the air, i.e., lead/wingman.
4. Do not run out of fuel.
5. Do not let anything shot from the ground or air hit the aircraft.

Changes In Priorities. There may be shifts in priority items, but they are never completely removed. For example, at 20,000 feet in close formation in the weather, avoiding a midair collision is of bigger concern than hitting the ground.

Psychological Considerations

A fighter mission demands total involvement, whether it be actual combat or continuation training. This means being mentally and physically prepared for the mission. Mental preparation requires setting aside outside stresses, allowing for total concentration on the Mission. Physical preparation means conditioning the body for the extraordinary demands of aerial combat and adopting a healthy lifestyle. This is an attitude! The fighter pilot's attitude is a proper blend of pride, desire, aggressiveness, and knowledge.

Physiological Considerations

USAF fighter aircraft can currently exceed aircrew tolerance for sustained high Gs. This capability often allows aircrews to apply more Gs than their bodies can tolerate; after a short "grace period," oxygen available to the brain is depleted and consciousness is lost. Aircrews must anticipate G onset, control the G onset rate, and coordinate their G straining maneuver. This takes mental discipline and practice to master. Failure to do so could spell disaster. GLOC (G-induced loss of consciousness) has two serious traits. First, it is more dangerous than other aircrew stresses because it is not possible for the person to accurately and reliably know how close he is to the GLOC threshold. Secondly, since amnesia (of the incident) is a characteristic of GLOC, someone may never know that he has ever lost consciousness and, therefore, may not be cognizant of any "close calls" he's lucky enough to have survived. The best solution to the GLOC problem is keyed to aircrew awareness. The aircrew has ultimate control over G stress factors. Here are some factors to consider:

Flight Factors. High onset rates and long periods of sustained high G seem to bring a person's body to the brink of exhaustion more quickly than at lower G levels. High onset rates can bypass the normal stages of reduced vision resulting in near-instant unconsciousness.

Diet, Conditioning, and Rest. The fighter crew member on a good diet, with proper physical conditioning and adequate rest, is mentally and physically prepared to meet demanding mission tasks. The lack of respect for any one of these factors could turn a high-G environment into the basis for a safety board. There is also a synergistic effect when more than one of these factors is below standard. Be prepared, mentally and physically, for high-G stress.

Currency, Anxiety, Aggressiveness. G tolerance is increased through practice. Layoffs such as a long leave, DNIF (duties not including flying), or even just coming out of a low-G flying phase requires a build-up of G tolerance. Anxiety in new situations or other pressures can mask your objectivity in assessing your tolerance. Aggressiveness, if not properly controlled, can lead to overconfidence and inattention to, or disregard for, bodily warning signs of fatigue and stress. Aircrews need to be aware of these factors and be on guard for signs of G-stress limits. An individual's G tolerance and warning signs can vary significantly from day-to-day. Fatigue, tunnel vision, or gray-out are critical warning signs that you are already at your limit. Do not attempt to maneuver your aircraft up to these limits; there is no buffer/reliable safety margin. When you suspect your effectiveness is being reduced, you must take appropriate action.

Misprioritization and Basic Situation Awareness

Misprioritization in any mission will result in channelized attention and can have disastrous results. By preparing for each mission and defining objectives incorporating the lowest common denominator, you can delay or deny task saturation factors. Each member of the team must mentally fly the mission before he straps on this jet (chair fly/hangar fly).

Search for situations that are most critical and mentally address what would happen in your cockpit: instrument cross-check, change switches, check your six, check your mates' six, check gas, audibilize a "surprise," have an emergency. Stress basic situation awareness. It must be developed and kept "current." Mentally engaging a MiG simply isn't enough. "Look" at the fuel gauge and comprehend what it tells you. Get the "big picture"; strive for "no surprises."

Objectives

Mission Objectives. Base preparation for any given mission on mission objectives. The mission objectives give the "big picture" of what is happening. The specific objectives are performance statements used to measure individual and team success during the mission.

Objective Components. A valid objective has three parts: performance, conditions, and standards.

1. Performance. What each aircrew or the flight does during the mission. It describes action and is not vague. Use action verbs such as employ, practice, negate, etc.

2. Conditions. Starting parameters such as "from an offensive perch" or "on a controlled range with BDU-33 practice ordnance ..."

3. Standards. States how well the performance must be done, and is categorized by time limits, accuracy, and quality, i.e., "meeting valid kill criteria" or "hits within 10 meters."

Defined Objectives. Defining objectives also depends on contingencies and other planning considerations: weather, sun position, day or night, the threat, or the fragmentary (frag) order are a few. Well-defined objectives are based on the mission requirements and the particular mission's most limiting condition. Clear objectives limit the impact of distractions and focus attention on mission accomplishment.

Mission Preparation

General. From a basic student upgrade sortie to a complex combat scenario, the success of any F-15E mission demands thorough preparation. This preparation consists of two phases — mission planning and mission briefing. Incomplete preparation in either area degrades mission accomplishment.

Main Factors

The two main factors which determine the direction of mission preparation are the role of the F-15E for the particular mission (offensive counter air, interdiction, combat air patrol, etc.), and the overall mission objective (combat target destruction, etc.).

Additional Factors

a. Flight composition (size of flight and experience of flight members)

b. HHQ (higher headquarters) guidance

c. Support forces (controlling agencies, communications, refueling, etc.)

d. Routing

e. Threat

f. Weather

g. Aircraft configuration (fuel tanks, LANTIRN pods, weapons load)

h. Weapons delivery options

Mission Planning Accomplishment

The flight leader establishes priorities for mission planning and delegates them to flight members to ensure all planning considerations are addressed while precluding any duplication of effort. The A/A and A/S chapters of this volume contain additional information specific to these roles. The depth of planning detail is dictated by the mission and flight experience level, but the bottom line is: all necessary mission planning is completed in time to conduct a concise, comprehensive briefing.

Briefing

Mission Briefing. The briefing sets the tone for the entire mission. Establish goals to accomplish and have a plan to accomplish them. Write the mission objectives on the board. Outline the standard which measures successful performance.

Standard Briefing Items. Start, taxi, takeoff, recovery, and relevant special subjects are covered in an efficient manner. Elements of the mission which are standard are briefed as "Standard." Spend most of the time describing the "what" and "how to" of the mission.

Mission Support. If adversaries, friendly players, intelligence (intel), or other mission support personnel are present, brief them first on only pertinent information and the mission. Ground controlled intercept/airborne warning and control system (GCI/AWACS) controllers, however, need to receive the entire tactical briefing. Alternate missions are less complex but also have specific objectives.

Briefing Technique. The flight lead needs to be dynamic and enthusiastic. He motivates and challenges the flight to perform to planned expectations, asking questions to involve flight members and determine briefing effectiveness.

Flight Leadership

Flight leaders have the general responsibility for planning and organize the mission, leading the flight, delegating tasks within the flight, and ensuring mission accomplishment. They are in charge of the resources entrusted to them; they must know the capabilities and limitations of each member of the team. Once airborne, they have the final responsibility and controlling authority for establishing the formations, maximizing the flight's effectiveness, and leading the flight successfully to and from the target.

Wingman Responsibilities

General. Wingmen have the supporting role in the flight. They help the leader plan and organize the mission. They have visual lookout and radar responsibilities, perform back-up navigation tasks, and are essential to target-destruction objectives in a surface attack role. Wingmen engage as briefed or when directed by the leader and support when the leader engages. It is essential wingmen understand their briefed responsibilities and execute their contract in a disciplined manner.

Flight Discipline. Discipline is perhaps the most important element for success in any aspect of aerial combat. On an individual basis, it consists of self-control, maturity, and judgment in a high-stress, emotionally-charged environment. Teamwork is an integral part of discipline; the individual evaluates his actions and how they affect the flight and mission accomplishment. If all flight members know their respective duties, they work together as a team. Experience and realistic training leads to solid and professional air discipline.

Debriefing

Purpose. The objective of the debrief is to determine if the desired mission objectives were achieved and what aspects of training need improvement.

Preparation For The Debriefing. Reconstruction of the mission objectives occupies much of the debriefing. Before the debriefing, use everything available — [VTR, notes, range scores, and air combat maneuvering instrumentation (ACMI)] to reconstruct the mission and develop the evaluation. Preparation before beginning debrief with the flight members and adversaries provides a well-controlled, effective debriefing. An honest assessment of accomplishments is more important than "winning the debrief."

Debriefing Technique.

1. General. Get the small items out of the way first. Discuss significant departures from the briefed flow or established procedures without belaboring the items. Review the mission objectives and provide a general impression of mission success.

2. Complex Missions. Some missions do not lend themselves to detailed reconstruction. Choose only the significant events that impact the objectives of the ride. The final summary includes an assessment of strong and weak points and the required corrections.

Formation Responsibilities.

1. Basic Responsibilities. The flight leader is always responsible for the flight. Each pilot is responsible for his aircraft. The WSO assists the pilot in a variety of ways depending on the situation. This involves crew coordinating certain responsibilities for the WSO, but also involves more direct interaction, such as providing directive and descriptive commentary during a defensive reaction. Typical two-ship crew coordination looks like this:

The lead pilot is responsible for:

a. Flying his aircraft and controlling the flight.

b. Navigation.

c. Visual lookout.

The lead WSO is responsible for:

a. Visual/radar lookout.

b. Operating systems and assisting the pilot in navigation, threat permitting.

c. Monitoring formation, to include directive commentary when required for turns.

The number 2 pilot is responsible for:

a. Flying his aircraft/avoiding terrain.

b. Formation position.

c. Visual lookout.

d. Monitoring navigation.

The number 2 WSO is responsible for:

a. Visual/radar lookout.

b. Monitoring formation, to include directive commentary for maintaining the briefed formation.

c. Operating the systems and assisting in navigation, threat permitting.

3-3 EXCERPTS: AIR-TO-AIR

Use of the Environment

Despite the technological advances in A/A radars and all-aspect weapons, there are still valid A/A tactics involving use of the sun, clouds and terrain. These environmental factors are employed to spoil the enemy's use of his advanced weapons, and enhance friendly aircraft capability.

Sun. From the earliest days of aerial combat, use of the sun has been a primary tactic. Using the sun in a visual engagement not only denies/delays the enemy a tally; it also denies or degrades any IR missile shots the adversary has available. Flying between the sun and the bandit places the aircraft at a higher altitude, forcing the enemy into a look-up missile shot. This decreases his range capability and gives the friendly aircraft greater potential energy due to the higher altitude.

The sun can also be used at low altitude, or when flying below the enemy's altitude, especially when the sun is low on the horizon. This forces the bandit to look into the glare of the sun, instead of easily spotting the friendly aircraft down-sun. Both the friendly aircraft and its shadow are tougher to see when searching into the sun.

Clouds. Clouds create problems for both the friendly aircraft and the bandit. Flying under high altitude clouds highlights the friendly aircraft against the light background. Considering today's radar and missile technology, flying in clouds to avoid detection only forces the aircrew to fly on instruments and lose mutual support. Flying above a solid deck knowing the enemy is below it, however, may give the friendly aircrew the element of surprise. Flying high enough above an undercast may allow time to visually detect and react to the threats climbing up through the cloud deck. Bright sunlit clouds usually pull off IR seekers.

Terrain. Low-altitude flying offers several advantages. First and most obvious, terrain can be used directly by placing ridge lines between the aircraft and the threat. Indirect terrain masking involves flying close to terrain features, but on the same side as the threat. Visual detection is degraded due to camouflage effects of the terrain behind the aircraft, and most radar systems have less success picking up an aircraft in the ground clutter, especially in rough terrain or when passing through the beam. Tally on the enemy is easier when the friendly

aircraft is down low, and the lower position gives the friendly aircrew a "blue-sky" shot at the bandit. The bandit, on the other hand, has to contend with the problems of IR missiles tracking hot spots on the ground and radar shots lost due to look-down in the beam.

Low-altitude flying unfortunately has several disadvantages as well. Low-altitude flying requires greater concentration to avoid the ground, reducing the time available to run systems or visually clear. At low altitudes, the APG-70 radar sensitivity is gained down to reduce clutter which reduces detection range as well. When flying at low altitude, most friendly missiles have reduced range compared to those of a high-altitude enemy, due to the uphill climb and denser air created by the low position. Finally, flying at low altitude gives the aircrew only one vertical direction to maneuver, limiting BFM (basic fighter maneuvers) if forced to turn and fight.

Principles/Concepts Of Basic Fighter Maneuvers (BFM)

Introduction

BFM is the application of concepts introduced in the AHC (aircraft handling characteristics) rides. BFM reflects a combination of three basic actions; an aircraft can roll, turn, or accelerate. BFM is a blending of these three basic maneuvers to gain either an energy advantage, a positional advantage, or (ultimately) both relative to another aircraft. The primary purpose of BFM is to enable you to maneuver your aircraft into weapons parameters to employ ordnance or deny a bandit entry into weapons parameters. BFM is not an exact series of maneuvers flown to specific conclusions, but is a complementary combination of maneuvers that blend into each other. These combinations are based upon a continual reassessment of the tactical situation. First, the fighter observes where the bandit is and what he is doing. He then assesses the bandit's energy state (maneuvering potential) as well as his own. From this, he predicts where the fight will progress, selects the most appropriate weapon, and/or maneuvers as required. The entire process of observation, prediction, and maneuver/countermaneuver is repeated until either a kill or disengagement is achieved.

Positional Geometry

In order to successfully execute BFM, the aircrew must understand their geometric relationship to the target and how it affects the ability to employ, or deny employment of weapons. The spatial relationship of two aircraft can be analyzed from three perspectives: positional geometry, attack geometry, and the weapon envelope.

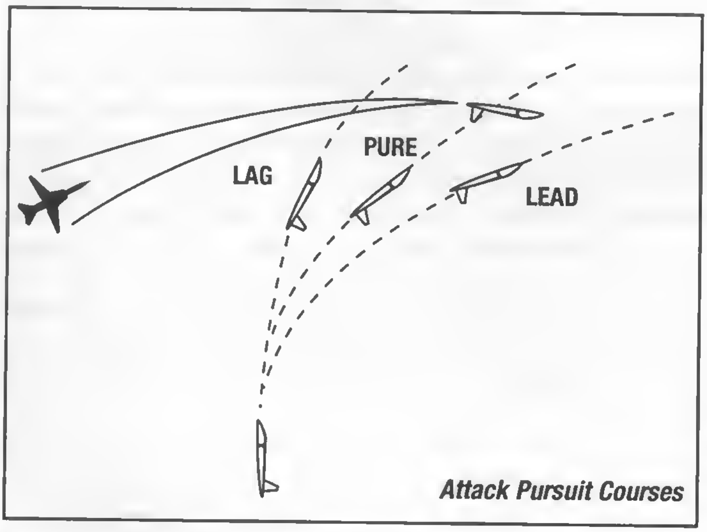
1. When discussing one aircraft's position relative to another, range, aspect angle, and angle-off (heading crossing angle, or HCAI) are used to describe angular relationships. These three factors dictate which aircraft enjoys a positional advantage, and how much of an advantage it is.

Range is the distance between two aircraft.

Aspect angle describes the relative position of the attacker to the target, without regard to the attacker's heading. It is defined as the angle measured from the tail of the target to the position of the attacker.

Angle-off is primarily concerned with the relative headings of two aircraft. Angle-off is defined as the angular relationship between the longitudinal axes of the attacker and the defender. Whenever the attacker is pointing at the defender, the aspect angle and angle-off are the same.

2. There are three available attack pursuit courses: lead, lag, and pure (figure below). The attacker's nose position or his lift vector determines the pursuit course being flown.



Attack Pursuit Courses

If in the defender's plane of turn, the attacker's nose defines the pursuit course. If the attacker's nose is pointed in front of the defender (such as in the case of a gunshot), the attacker is in lead pursuit. If the attacker points behind the defender, the attacker is in lag pursuit. If the attacker points at the defender, pure pursuit results.

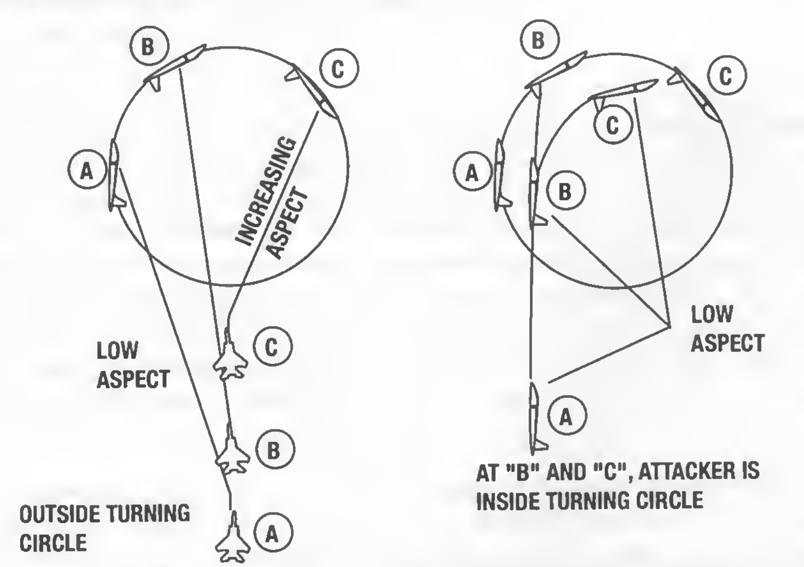
Weapons Employment Zone (WEZ)

The vulnerable cone of a defender is defined using range, aspect, angle-off, and pursuit course to approximate the employment envelope for a specific type of ordnance. This is the maneuvering goal of BFM. The attacker wants to arrive at the WEZ to employ ordnance, and the defender wants to deny the WEZ to survive. BFM is used when necessary to change range, aspect, and angle-off to positions in space relative to the WEZ.

Turning Room

Turning room is the separation between the two aircraft that can be used to accelerate, to decrease range, or turn and decrease aspect angle and angle-off. A turn circle is defined by aerodynamics and is based on a certain size (turn radius) and how quickly an aircraft can move its nose (turn rate). The determinant of whether an aircraft is (at any instant in time) "inside" or "outside" of a defender's turn circle is the relationship between the attacker's range and the defender's turn radius. If the attacker's range to the defender is greater than the defender's turn diameter, the attacker is outside the turn circle. An attacker is inside a defender's turn circle when the defender's turn can no longer bring the attacker forward of the defender's 3/9 line.

Outside/Inside the Turn Circle.



1. The attacker's nose position (i.e., lead or lag) relative to the defender's current position and flight path does not strictly determine whether the attacker is inside or outside the defender's turn circle.

2. As the defender bleeds off energy and airspeed while performing his defensive turn, his turn radius decreases. His turn rate also decreases, once the defender slows below his corner velocity. As the defender's turn radius decreases due to increased G loading and/or energy bleed, an attacker that started inside the turn circle may end up outside due to inability to match the defender's decreasing turn radius, a decision to maneuver to lag outside the turn circle, or simply mismatched but equal turn circles. It is very important to note that turning room can be acquired in either the lateral or vertical planes or a combination of both. Another important note is turning room can be used by either aircraft.

3. Lateral turning room is in the defender's plane of motion. The defender's turn direction (into or away from the attacker) affects how much turning room is available. If the attacker is inside the defender's turn circle, he must have a turn rate and radius capability that allows him to "make the corner" the defender presents. The disadvantage of lateral turning room inside the defender's turn is that it frequently requires high energy bleed rates to generate the turn rate and radius required to make the corner and stay in the defender's plane of motion. If the defender turns away from the attacker, turning room increases as the attacker is no longer inside the defender's turn circle. In this case, part of the geometry problem is being solved initially since the bandit is rotating his vulnerable cone towards the attacker.

4. Vertical turning room is acquired out of the bandit's plane of turn. If the bandit is in a vertical turn, this turning room may be in a horizontal plane. If the bandit is in the horizontal, then turning room is available either above or below his plane of motion. Range and closure govern the amount of turning room that can be generated. Energy can be gained while maneuvering for turning room below. If you elect to go for turning room above the bandit, you must have the airspeed to drive above the bandit while retaining sufficient energy to continue the attack. Remember turning room for the attacker is also turning room for the defender. Turning room required is based on an aircraft's turn performance and turn geometry; therefore, a more maneuverable aircraft does not require as much turning room as a less maneuverable one.

5. Turning room is normally established as the attacker transitions inside the defender's turn circle. Trying to establish vertical or lateral turning room outside the turn circle can result in the attacker becoming the defender.

Mechanics of BFM

This section examines the three basic principles of BFM: roll, turn, and acceleration.

Roll

Roll allows you to position your lift vector, thus determining the plane of motion in which you turn. At high speed and low AOA, the F-15E has a very high roll-rate capability. However, as the airspeed slows and AOA builds, the roll performance begins to degrade. At slow speed, in order to roll more rapidly, the AOA must be reduced prior to initiating the roll. It should also be noted that the slower the airspeed, the longer it takes to command a reduction of AOA.

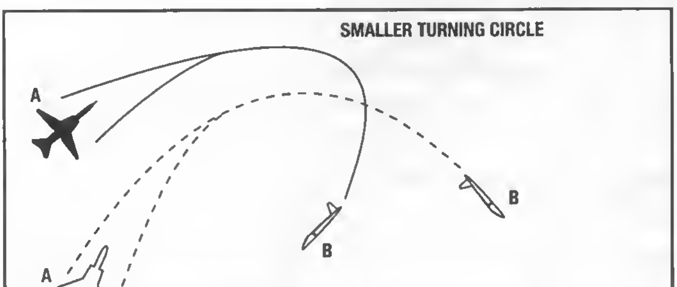
a. An important aspect of roll is the ability to slow the forward velocity of the aircraft. If G is maintained and a roll is initiated, a spiral is made in the flight path, thereby increasing the "through the air" distance the aircraft flies to arrive at any selected point.

b. An additional benefit of roll is the ability to position the bandit to maintain a tally. This is especially useful with an aft quadrant bandit where a simple roll to maintain line of sight (LOS) is preferable to energy depleting "kickouts."

Turn

Turn radius determines the size of the turn circle. This radius is based on the aircraft's TAS (true airspeed) and radial G. Note that turn radius changes exponentially as velocity (airspeed) changes and only linearly as the radial G changes. This is why airspeed is so important in determining turn radius. Above 450 KCAS, turn radius increases dramatically.

Offensively, sustained operations are not possible *in the same plane* against a defender with a smaller turn circle (radius) assuming similar turn rates without inviting an overshoot/reversal situation.



Attacking an Aircraft With a Smaller Turn Circle.

Even if the attacker has the identical turn rate/radius capability as the defender (1v1 similar), the attacker is unable to sustain operations in the same plane to the degree the center of the two turn circles are offset. A defender wants to decrease his turning circle as much as possible. *This is because a superior turning aircraft cannot use its better turn capability inside a defender's turn circle.* An earlier turn merely effects an "in-place" turn.

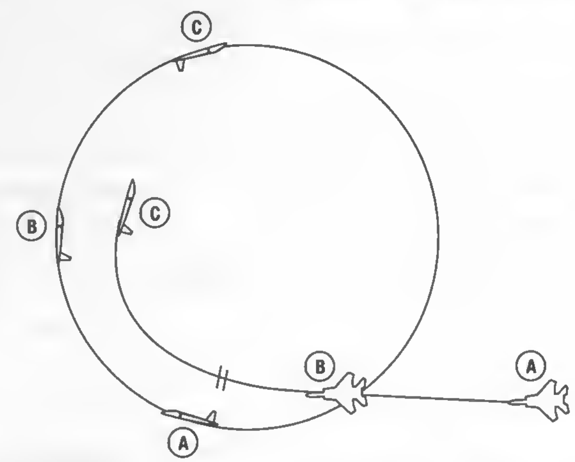
The attacker's solution to the situation described above (outside defender's turn circle) is to maneuver into the defender's turn circle (see figure, below). This involves initially pointing to lag. The ability to enter the defender's turn circle and control geometric closure by initially pointing to lag is an important concept in BFM.

Turn Rate. Turn rate is needed to achieve weapons parameters or defeat attacks. The F-15E's turn rate increases very rapidly from slow speed up to 420 KCAS, at which point the rate is the highest. Rate allows the attacker to match or exceed the turn rate of his adversary and pull his nose onto the bandit, while remaining within the bandit's cone for a missile attack or point to lead pursuit for a gun shot.

It is important to note an attacker with a higher sustained turn rate can maintain a positional advantage against a defender with a smaller turn radius but reduced rate. The ability to maintain a high sustained turn-rate while the defender sacrifices sustained rate for a tighter turn is another key concept in understanding offensive BFM. In this sense, a turn rate advantage is more tactically significant than a smaller turn radius.

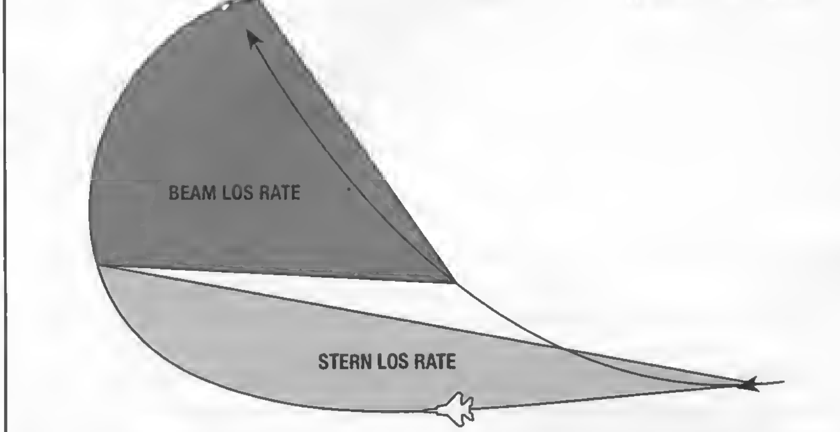
Rate is also used to defeat threats. A defender can use rate to drive an attacker into a lag position and thereby deny a missile shot or a gunshot opportunity. In close, if the attacker has already established lead, the defender can roll and turn out of the bandit's plane of turn to spoil his gunshot solution.

Lag Entry Inside the Turn Circle



Defeating missiles with turn rate. A missile fired in the aft quadrant can be defeated by rotating the aircraft toward 90° aspect angle with regard to the missile. This generates the maximum line-of-sight (LOS) problem for the missile and hopefully exceeds its gimbal tracking capability or its turn capability. As already discussed, a smaller turn radius enhances the overshoot probability of the missile, but the missile will still kill if the overshoot occurs within fuze functioning distance of the target. A higher turn rate, not a small turn radius, is necessary for a successful missile defense. To achieve the highest turn rate possible, slow or accelerate towards corner velocity speed as quickly as possible and turn hard to generate maximum angles in the shortest time. The maximum LOS problem for a missile occurs at 90° of aspect angle (figure below).

Missile LOS Rates



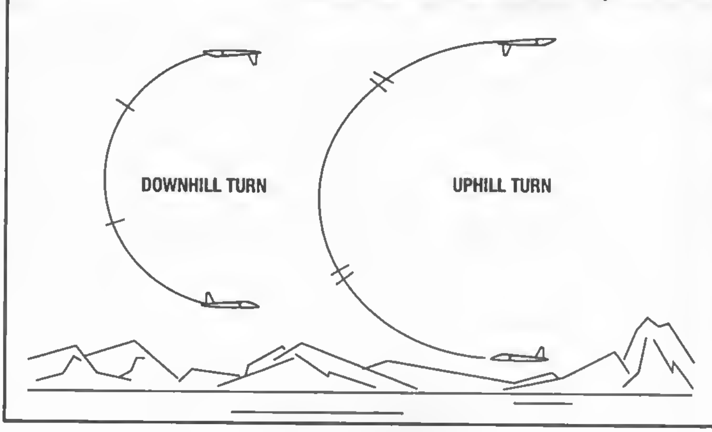
Vertical Turning. Turn rate and radius are affected by the earth's pull (gravity). Any time the aircraft's lift vector is above the horizon, turn rate is decreased and turn radius is increased. If a loop were performed at a constant (cockpit) G, the flight path would be characterized by an "egg' shape.

If an aircraft is able to turn with the lift vector below the horizon, turn rate increases and radius decreases (assuming constant airspeed and cockpit G). The converse is true during turns with lift vector above the horizon (figure, p. 132).

Another important concept of vertical turning is optimizing turn rate and energy (airspeed) expenditure. Utilizing available G while entering a purely vertical turn (loop) excessively bleeds energy while "working against" gravity. Generally, a lower G vertical turn is more efficient at the beginning and end of a loop, while

maximum G (maximum rate) vertical turns can be best employed when working "with" gravity — from nose pointing straight up until nose pointing straight down. BFM technique in a vertical "egg" fight can be summarized by the rule of thumb: "Lead across the top; lag across the bottom."

Comparison of Downhill and Uphill Turns



Additionally, turns performed in the "pure" vertical (i.e., no lateral or horizontal component) deny a trailing (similar) aircraft, at a lower energy state, the capability to counter the result of the energy differential by performing an oblique or horizontal turn.

Acceleration

The three primary factors affecting acceleration are altitude, AOA, and airspeed.

The lower the density altitude, the more effective the acceleration is because of increased thrust. The fastest airspeed gains occur by selecting full AB and flying 7-9 units AOA. Additional acceleration is gained by going downhill while maintaining optimum AOA. As a technique, do not allow the nose to drop more than 30° low. This is especially true when separating from a bandit, because the pull-out to level flight at low altitude allows the bandit to arc the turn in the vertical. At low altitude, fly a 1G acceleration to avoid the ground (speed less than 400 KCAS), or to avoid an arcing turn (airspeed greater than 500 KCAS).

Acceleration is a trade-off between thrust and drag. Thrust increases at a greater rate than parasite drag as velocity increases over the speed range of 100-450 KCAS (or 0.95 Mach, whichever comes first) due to the ram-air effects on the engine. Above 450 KCAS, acceleration rates decrease as drag becomes dominant (both parasite drag and compressibility drag). As a rule of thumb, the best acceleration rates occur in the 300-450 KCAS speed range.

Offensive BFM

The primary consideration in offensive BFM is to kill the bandit by arriving in weapons parameters as soon as possible and taking the shot. Understanding the concepts of turn rates and radius just described is mandatory to assessing which BFM discussed in this chapter works in which instances. It should be remembered that BFM is not a fixed set of maneuvers, but rather, combinations of rolls, turns, and accelerations that have been optimized for certain situations and named for the sake of discussion. Since the end goal of any offensive engagement is to kill the bandit, offensive BFM is designed precisely to do just that with minimum time and energy expended.

Objectives of Offensive BFM

1. The first and primary goal of offensive BFM is to kill the bandit. In order to do this, recognize weapons parameters and employ ordnance once in those parameters. If you cannot shoot, reposition to maintain positional advantage until you can employ ordnance.

2. Maintain an offensive advantage through energy and geometry management.

3. Separate prior to becoming defensive. Recognize when the fight is becoming "neutral" and separate while you are still in control of the situation.

The first set of maneuvers to be examined are large turn maneuvers designed to solve high aspect, high angle-off, and long range BFM problems. Hopefully these maneuvers are preceded by an AIM-7/AIM-120 shot. It is important to note that any maneuver performed at long range may be negated by the defender. This means the defender has the ability to point at the attacker while negating any turning room developed by the attacker.

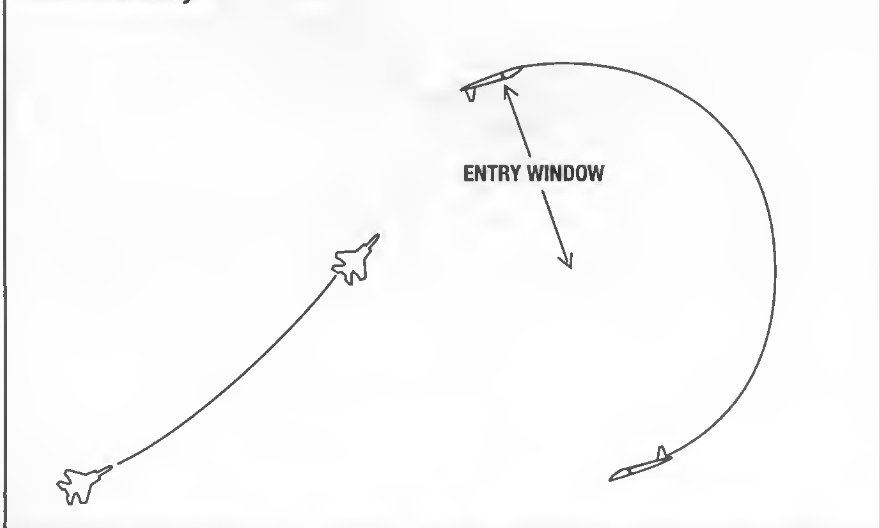
The primary emphasis should be toward arriving inside the bandit's turn circle in minimum time. The attacker's goal is to fly into the defender's turn circle to reach an offset point from which a max turn can be made to a slight flight path overshoot (nose in lag), approximately one radius behind the defender (2500-4000ft).

Acceleration Maneuver

Offensively, this maneuver is used to gain airspeed and overtake (if desired), and to decrease range. The energy gained during this maneuver can be used to solve angle-off problems during the terminal phase of the attack. The quicker the range can be decreased to where the attacker is inside the opponent's turn circle, the less time the defender has to generate angles that must be solved with future BFM. However, the more airspeed that is gained above corner velocity, the greater the degradation on the attacker's instantaneous turn capability. Remember the concept of "observe, predict, and maneuver." The pilot should first note the direction of his opponent's turn and establish a pursuit course based on the range, aspect, angle-off, and the comparative size of the two circles.

If the acceleration maneuver allows a transition to inside the defender's turn circle, the best pursuit course is located between the defender's initial start position, and the center of his turn circle (see below). The pursuit course should never be outside the defender's turn circle. Any attempt to establish a lead pursuit course only results in a higher aspect when transitioning inside the defender's turn circle with less room to solve the resultant BFM problems. Care should be taken not to gain more airspeed than can be managed, normally 420-460 KCAS. Additionally, nose position should remain within 30° of the bandit's plane of motion.

Turn Circle Entry



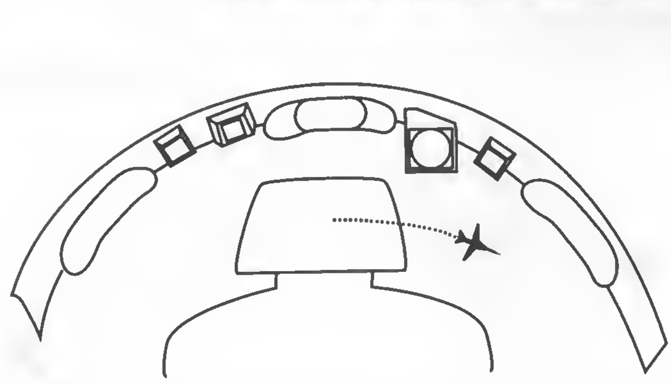
Approaching the Turn Circle

While accelerating toward the bandit's turn circle, monitor his turn performance to estimate his energy state and the size of his turn circle. Modify the pursuit course, as required, to accommodate changes in the bandit's turn circle size. A pursuit course oriented toward the point where the bandit started his defensive turn is normally more conservative and allows more room for error (see figure on previous page). This pursuit course is required against a bandit with turning performance similar to the F-15E. This pursuit course may also be appropriate against an inferior turning bandit or one with limited BFM skills.

Determining When Turn Circle Entry Occurs

Prior to entering the bandit's turn circle, he appears to pivot in space. His aspect angle appears to rapidly increase and there is little apparent LOS rate (relative to the horizon or across the canopy). Projecting his flight path through his defensive turn confirms he is unable to point his nose directly at you. As turn circle entry occurs, you will note the bandit's aspect angle appears to stabilize or decrease and his apparent LOS rate rapidly increases rearward along your canopy. Let the bandit drift 20-30°, just approaching the canopy bow (figure below). At this point, you are inside the bandit's turn circle and can begin BFM.

Bandit Drift with Some Vertical Turning Room



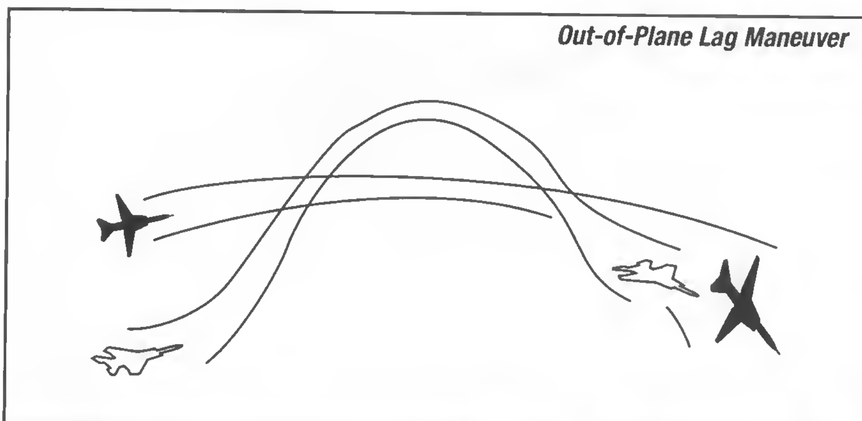
Mistakes in Long-Range BFM

1. Insufficient lateral turning room due to excessive pure pursuit while outside the bandit's turn circle — results in an overshoot and, possibly, a reversal.
2. Too much lateral offset or lag pursuit — results in releasing pressure on the bandit, increased range as he extends away, or the defender's use of the turning room to reach nearly neutral conditions.
3. Too much vertical turning room too early (while outside the defender's turn circle) — allows the defender to use the turning room to potentially create high-aspect BFM.
4. If the engagement begins closer to but still outside (6000-foot range) the turn circle, the initial moves remain essentially the same. However, the attacker arrives within the turn circle much sooner.

In this case, a similar maximum performing defender produces approximately 80-90° of aspect before the attacker enters the turn circle.

Take an AIM-7/AIM-120 shot and begin a roll away from the bandit to obtain some lateral turning room while driving toward the turn circle. Less lag is needed (10-20°) since the defender generates less turn before the attacker enters the turning circle. Some vertical turning room is obtained since the defender has less of an opportunity to use it against the attacker. This out-of-plane flight path (sometimes called a high yo-yo) allows the attacker to control closure while decreasing AA (figure below).

The canopy bow rule works. Roll back into an in-plane lag with the bandit just inside the canopy bow.



BFM Inside the Turn Circle

Once inside the bandit's turn circle, the objective is to control aspect, angle-off, and range while maneuvering toward a position to employ ordnance. This is the control position. Turn circle entry should have occurred with an energy advantage which can now be utilized to generate turn rate. At this time, roll into an in-plane lag and begin a maximum-turn-rate turn to hold the bandit no higher than just below (inside) the canopy bow. Pull to the maximum G allowable. As airspeed decreases through corner velocity, anticipate the need to blend in full AB to sustain a maximum rate turn.

1. The bandit may attempt to extend or separate when you are not in a position to employ ordnance. This extension may provide a missile shot opportunity, and/or may place you outside his turn circle. If outside the bandit's turn circle, anticipate the lag AIM-7/AIM-120 shot.

2. If the bandit continues a hard turn, closure must be controlled. Both throttle/speed brake and lift vector control should be used. If an in-plane turn will align fuselages for a gun shot, do so. If an in-plane turn will not provide a shot opportunity, ease off the G loading and maneuver to a lag pursuit course to control closure (high yo-yo). Continuing a pure pursuit course will result in an overshoot; the bandit will appear to stop in space and closure will increase rapidly.

3. Establishing the Control Position. After this initial turn, with closure, aspect, angle-off and range under control, a control position is established. From this position, use small repositions to achieve weapons parameters.

Achieving the WEZ

Once inside the bandit's turn circle, combine lead, pure and lag pursuit with in-plane and out-of-plane maneuvers to solve aspect, angle-off, closure and range (a series of high and low yo-yos). In order to achieve weapons parameters, without concern of overshooting the 3/9 line (the plane defined by an aircraft's 3 o'clock/9 o'clock; it separates everything in front of the aircraft from everything behind it), all of these must be under control at the same time.

When the bandit extends, bring the nose onto him for a missile shot opportunity. When he turns, maneuver as required to lag pursuit to control closure and solve aspect (high yo-yo). If the bandit continues to turn, angle-off and aspect increases. When aspect is solved, the bandit moves toward the HUD. Transition to a lead pursuit course and use radial G to solve the angle-off (low yo-yo). Continue the low yo-yo until the bandit's turn begins to create aspect. Transition to a high yo-yo to solve the aspect. Repeat the high/low yo-yo series until he can no longer generate a turn which increases aspect or angle-off. During the high/low yo-yo series, control range and closure by maintaining approximately 2000 - 3000 feet in range and approximately +50 KCAS Vc (velocity of closure) relative to the bandit. Modulate power as required to control closure and maintain range. Align the fuselages and take the missile shot or close to guns range without fear of overshooting the 3/9 line. If the gun shot is defeated by jinking, reposition to maintain the control position.

Slow Speed Fight

If late recognition of undesired closure/range occurs, the bandit may reverse and force a slow speed fight. There are three common types of slow speed fights: flat scissors, rolling scissors, and high/low stack.

Flat Scissors. This is the result of an in-plane overshoot. Given an energy advantage, exclusive use of the vertical may exist. If so, reposition high above the bandit. Be patient and drive to his six o'clock position prior to committing the nose back down. When the bandit begins to move forward on the canopy, pull to his six o'clock to establish a 3/9 line advantage. If both of you are pulling for a high six o'clock position and neither establishes a 3/9 line advantage, a rolling scissors results.

Rolling Scissors. Here, the pilot that can point, intimidate, and cause the other pilot to stop pulling should have the advantage. If unable to do so, then stop the rolling when the nose is above the horizon and the bandit's nose is below the horizon. By rolling out with the nose above the horizon, forward velocity is slowed. Because the bandit's nose is below the horizon, he should have a greater forward velocity. This should result in a 3/9 line advantage for you. When a rolling scissors transitions to a horizontal fight (neither pilot having a 3/9 line advantage), the fight may result in a high/low stack.

High/Low Stack. A high/low stack can result from an overshoot in the vertical or from stopping a rolling scissors. If you are the high man, use power to gain turning room above the bandit. Keep sight by weaving slightly during the climb. Be sure to keep the nose above the horizon to prevent an increase in forward velocity. Attempt to get your nose out of synchronization (sync) to gain lateral as well as vertical turning room.

At approximately 3000 feet of turning room (adversary outside the turn circle), maneuver to gain 3/9 line advantage. While the high man has a slightly higher potential energy, the low man has the advantage of an easy tally. As the low man, try to mirror everything the bandit does to force his loss of sight, but not to the point of losing lift. This denies him lateral and vertical turning room, forcing the bandit to roll to regain sight. If he rolls excessively, his nose drops, increasing his forward velocity. Once the 3/9 line advantage is gained, maneuver to the bandit's six o'clock and attempt a gun shot.

The low man's best chance to bugout is to maneuver into the high man's blind zone. You should time the bugout and accomplish a split-S maneuver (altitude permitting) when the high man is not looking. As you complete the split-S, you must regain the tally to determine if the high man detected the bugout and poses an immediate threat or if the separation was successful.

Separations. All offensive BFM is designed to maneuver into weapons parameters. It is foolish to continue maneuvering against an adversary once you recognize you no longer have the potential to achieve shot parameters. Your goal now is to separate from that adversary before losing offensive position. Do not wait until a neutral or defensive situation develops to attempt a separation.

Defensive BFM

The following discussion of defensive BFM is predicated on an understanding of offensive BFM. In defense, realizing the mistakes of the attacker gives the defender his best chance of role reversal or escape. To recognize the attacker's mistakes, the defender must know offensive BFM concepts.

The primary objective of defensive BFM is survival. Unfortunately, you are looking over your shoulder, often under high-G load to accomplish this. More than any other situation in flying, defensive BFM is a physical problem. It hurts to pull Gs and look over your shoulder. The ramifications of being physically unprepared for the defensive BFM arena should be obvious.

Objectives

There is no magic maneuver you can use on defense which automatically changes you to an offensive position against a similar bandit. It is essential you maintain a tally so you can take advantage of the bandit's mistakes, assuming he makes any. Your maneuvering on defense must be weighed with keeping the tally. If the bandit doesn't make any mistakes, or makes fewer than you, the best you can hope for is to keep him from employing ordnance against you. As the engagement continues, this can become extremely frustrating and there is a tendency to give up. Your will to live must remain high. As long as the bandit isn't shooting, your defense is working.

There are two basic objectives of defensive BFM:

1. Survive the bandit's attack.
    a. Defeat any weapons employed by the bandit.
    b. Deny the bandit weapons employment opportunities.
2. Separate or kill the bandit.

Considerations

All BFM is performed relative to weapons employment zones (WEZ). Defensive BFM is used to change range, aspect and angle-off to prevent an attacker from achieving a position in the WEZ. This assumes a worst-case situation with a similar or more capable bandit at the defender's five to seven o'clock with overtake and a tally. All defensive maneuvering should be performed with the following rules of thumb in mind:

1. If you turn, turn hard. Any turn made to create BFM problems for the bandit should be made with lift vector directly on him and at the highest G-loading available. The nature of your turns demonstrates your resolve to the bandit (4 - 5G turns transmit a completely different resolve than an 8G turn); and against a capable bandit, this turn provides the greatest BFM problems.

2. When required, do your best extension/acceleration maneuver — remember, best acceleration is between 7-9 CPU (cockpit units) AOA. Despite the "unloaded" feel of 2 - 3Gs compared to 8Gs, less energy is gained than could have been at 1G or less. Energy-gaining acceleration maneuvers should be done in relation to the horizon. Uphill acceleration maneuvers defy the laws of physics and are highly discouraged. Slightly downhill accelerations give the best tradeoff of altitude and airspeed.

3. Maintain a tally on the attacker, force BFM problems, and as the attacker attempts to gain turning room to solve these forced BFM problems, take away or deny him turning room. If the attacker closes and overshoots, attempt to gain 3/9 line advantage. If the attacker repositions and prevents an overshoot, separate if the situation allows.

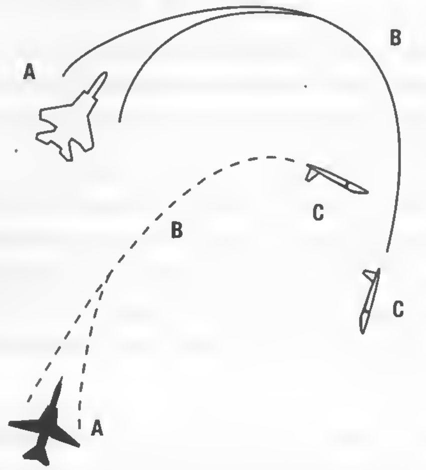
Defensive Maneuvering

If you visually acquire a bandit outside 2nm, turn to meet the bandit at high aspect and engage him offensively or separate. If you have sufficient energy, counter any BFM by pulling up into his plane of maneuver to use the turning room he is attempting to gain. Remember, a small bandit may be closer than you realize. If you initially acquire the bandit at a range of 2nm or less, assume he has closure. The WSO should direct the fight until the pilot has the tally, then monitor parameters, other threats, and the ground.

Defensive Turn

If the bandit is in-plane, every degree you turn generates another degree of aspect and angle-off for the bandit to solve. Until the bandit closes inside your turning circle, he cannot begin to match or exceed your turn rate without fear of flying in front (see figure on next page).

Defensive Turn Circle



1. Initiate a break turn into the attacker while employing countermeasures. Consider a MIL power turn versus AB if airspeed allows. Prevent the bandit from closing inside your defensive turning circle. Turn directly into the attacker's plane-of-attack to deny him turning room and dispense chaff and flares. Put the lift vector directly on or slightly below the attacker.

2. During the turn, monitor the movement of the bandit on the canopy. The purpose of the defensive turn is to generate an aspect problem for the attacker. If this occurs, the bandit moves forward from the 5 or 7 o'clock position across the top of the canopy towards your nose. If the attacker is not moving forward on the canopy, assess why.

3. A hard turn against an in-plane bandit generates an overshoot if the attacker does nothing to acquire additional turning room (i.e., BFM). Therefore, generate a large angle-off problem for the attacker as early as possible.

4. To continue presenting the attacker a problem, do not allow him use of split-plane maneuvering. If energy allows, reorient your lift vector near the bandit if he repositions out of your plane of motion.

Breaking Closure with a Turn

If you acquire the attacker in the 5 to 7 o'clock area at 9000ft, assume he has closure. Geometry in this case is similar to the 2nm situation, except the attacker is closer to your turning circle. You have less time to generate angles before the bandit attempts to match your turn rate.

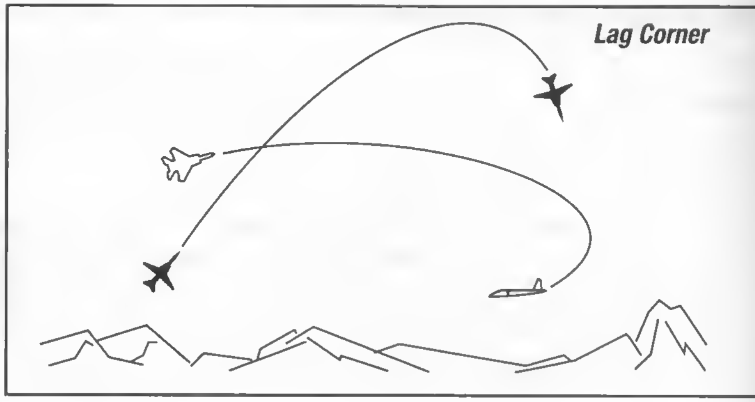
1. The bandit is closer to valid weapons parameters; therefore, if he is nose-on and/or fires ordnance, simultaneously employ chaff and flares while modulating power and execute a break turn by immediately slowing to corner velocity to realize the quickest instantaneous turn. The defensive goal is to bring the missile to 90° aspect as quickly as possible to maintain a high LOS problem.
2. Analyze the attacker's aspect. If the attacker is aft of the wing line with his nose in lead, he may be arcing for closure because he lacks airspeed. In this situation, extend away or continue to turn hard and meet him with high angles. Turn hard into the attacker if he is forward of the wing line, or if you know he has overtake and can close regardless of his aspect.
3. If the attacker comes nose-off, continue turning defensively to generate angles, but ease off if you need to maintain or gain energy. Due to the high energy bleed-off caused by high AOA, avoid exceeding 30 CPUs AOA whenever possible to generate the most angles over time.

Defensive Action: 6000 Feet

If you acquire the bandit at 5 to 7 o'clock and 6000ft, assume he is closing and react quickly — any missile-equipped bandit is already within weapons parameters.

1. A break turn while simultaneously adjusting throttles and employing chaff and flares is required if the bandit is nose-on or has a missile enroute. Immediately achieve maximum allowable G. Modulate throttles to achieve the correct power setting (from idle through full AB) to present the bandit with the toughest turn rate and radius problem possible. The turn rate problem is essential to defeat both the adversary and his missile. Throughout the defensive turn, maintain tally on the bandit and look for forward movement on the canopy to see if your defensive turn is working.
2. There are two possible reasons for an attacker to take his nose off the defender in a lag attack course. First, he has insufficient turn rate available to match your hard turn. Second, a superior turning bandit may use excess energy to drive to your blind cone, then slow his aircraft and turn harder to point and shoot unobserved. This maneuver is referred to as a lag corner.

To counter a lag corner, turn hard to rotate your vulnerable cone and maintain a tally with the attacker. The farther back the bandit, the more effective the turn to rotate your blind cone away.



Defensive Action: 3000 Feet

Defensive action is even more critical with the bandit at a 5 to 7 o'clock position and 3000-foot range.

1. At nose-on, execute a break to force the attacker into lag or an overshoot. Assume he has established sufficient lead for a gun shot if there is any doubt about nose position.

2. The attacker's nose in lead means you must start some type of gun defense. You must fly yourself out of his current plane of motion or bullet stream to defeat the attack. The lower the aspect, the longer he maintains firing position because of the lower angular closure.

3. A guns break is required in the higher aspect situation, assuming sufficient aspect has been generated to force an overshoot. You must roll your aircraft out of the attacker's plane-of-motion. At 135° of aspect, a 30° roll may be sufficient. You should unload to roll quickly to attain a full 90° to the attacker's plane at 45° of aspect.

4. A guns defense is required when the attacker is low aspect with controllable overtake inside gun range. Defeat the initial attack with an unload to near zero-G and roll out-of-plane. This maneuver is followed by a positive-G pull out of the attacker's plane of maneuver for about two to three seconds to allow the airplane to respond and move. If the bandit comes back nose-on, again change the defensive plane of maneuver. If the bandit's nose is off, continue pulling to generate a closure problem.

Several major errors may occur during guns defense. The first is losing tally. To avoid losing tally, note the opponent's position when initiating the first plane of maneuver change and predict where he is going during the defensive maneuver. Look over your shoulder for the bandit after a jink.

Another error is attempting to roll at high AOA. A rapid plane of maneuver change is essential and a slow roll rate is fatal. First, reduce AOA to achieve the quickest roll rate [unless the defense is initiated at sufficient airspeed (above 250 KCAS)] to guarantee an acceptable roll and turn rate. The most critical error is giving up and settling into a constant plane of maneuver turn by not holding the jink long enough.

Force Overshoot

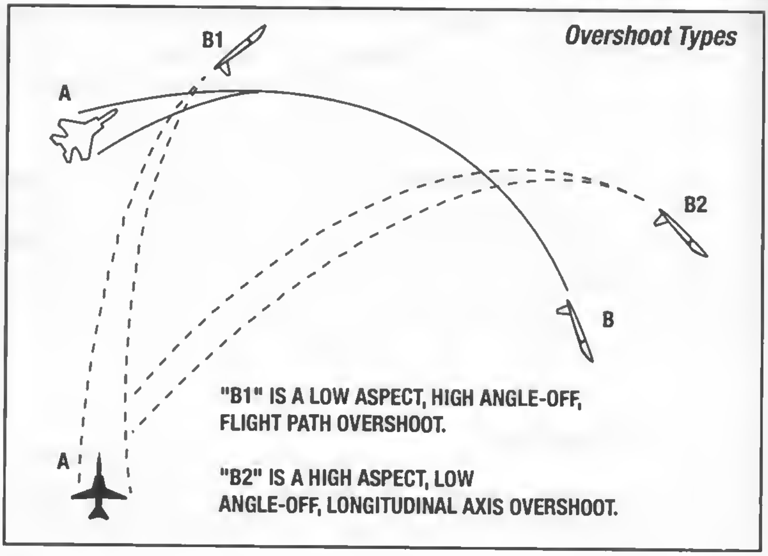
If your defensive plan is executed correctly during transition maneuvers, you have the opportunity to separate or force the attacker into a flight path overshoot. This gives you the chance to reverse and go offensive.

1. The attacker overshoots whenever he faces an angular problem he cannot solve inside your flight path. There are two types of overshoot geometry.

   The first is a flight path overshoot where the attacker crosses your smoke trail but remains inside your longitudinal axis. You must continue turning in the same direction to reacquire the tally and not offer the attacker a low aspect, low angle-off shot.

   The second is a longitudinal axis overshoot which crosses the attacker over to the other side of your aircraft. Your options are now based on three aspects of the overshoot: range, angle-off, and closure. The farther back in range the overshoot occurs, the less likely the possibility for a successful role reversal. The higher the aspect of the attack, the higher the angle-off is at the overshoot. The higher the angle-off, the more pronounced the overshoot and the more likely the possibility of the defender executing a successful reversal or separation.

   The final factor, the attacker's closure, is related to the angle-off and airspeed differential. The more closure the attacker has at the overshoot, the farther across your longitudinal axis he travels (see figure, next page). If you cannot reverse and gain the 3/9 line advantage, roll to change plane of maneuver, increase GR (radial G), maintain sight, and continue turning in the same direction.



2. The defender may react to the longitudinal axis overshoot with a reversal. Not all overshoots result in a reversal opportunity. If the overshoot occurs at long range, treat it as a 6000-foot, nose-in-lag defense. A flight path overshoot that does not overshoot your longitudinal axis is often not severe enough to warrant a reversal. If you doubt your reversal options, continue turning hard until a definite overshoot is generated. The intent of a reversal is to create either more angles or more closure problems for the bandit. If the combination of range, AA, angle-off, and closure is such that a reversal drives the bandit's nose off or flushes him toward your 3/9 line, then reverse — execution is based on the type of overshoot.

a. If the bandit overshoots at close range with high AA, angle-off and LOS (i.e., loss of 3/9 line advantage is likely) your priority is to reverse with a minimum expenditure of energy so you arrive inside weapons parameters. Unload and roll to place the bandit inside your turn circle, then pull to his 6 o'clock position to obtain 3/9 line advantage.

b. With lower AA and angle-off, gaining 3/9 line advantage is not as certain if the overshoot occurs at a longer range and lower LOS. Begin a loaded roll opposite the defensive turn direction with aileron and top rudder. If the nose hangs up, break AOA just enough to get the nose tracking again. If the bandit's position and LOS bring him to or forward of your 3/9 line, continue pulling toward his high 6 o'clock position. If, at the decision point in the reversal, the bandit is obviously maintaining the 3/9 line advantage, reestablish the defensive turn by dumping the nose, rolling into him, then slicing out of his plane of maneuver.

3. A common error made by an uneducated bandit, when faced with an aggressively maneuvering F-15E, is attempting vertical maneuvering outside the turn circle. Take advantage of the turning room by transitioning the plane of the fight to keep the lift vector directly on the bandit. The bandit continues to move forward on the canopy until an offensive lead turn can be made as you use the F-15E's turn rate capability to become offensive.

   A second common error made by offensive bandits is making an initial move to lag and a late recognition of turn circle entry, forcing the bandit to a deep lag position. This is recognized by an aft canopy movement which slows down with the bandit's nose well off as he begins his hard turn to threaten. Normally the best defense for this situation, against an inferior turning bandit, is to continue the hard turn. This forces the bandit deeper into lag and develops a neutral 'lufberry' which the F-15E eventually wins if it has a superior turning performance.

High-Aspect BFM

General

During the transition from the intercept to the BFM phase in the mutually detected situation, the bandit may be turning into the attacker based on something other than a tally. In this case, assume the bandit has a tally and continue attempting to gain turning room. If the bandit has a tally, a head-on merge is likely.

The objectives of high-aspect BFM are:

1. Maneuver to a weapons employment zone (WEZ) and kill the bandit.
2. Maneuver to an offensive position.
3. Separate before becoming defensive.

Maneuvering Considerations

The following discusses several basics in the high-aspect situation: turning room, lead turns, and vertical entries.

Turning Room. Turning room is displacement from the adversary's flight path in any plane. Turning room is available for either aircraft. The benefit of turning room is the ability to begin a turn toward the bandit before the merge. This is also known as a lead turn. The plane of maneuver used to obtain turning room (horizontal, vertical above, or vertical below) is a tactical decision. The size of your turn circle, turn rate capability, and the defender's airspeed determine the point you initiate the lead turn.

Lead Turn. Considerable judgment is required to properly initiate and execute a lead turn so as to arrive within the intended weapons parameters. It is important to stress that a lead turn requires the initiation of the turn forward of the defender's 3/9 line. (Remember turning room for one is also turning room for the other, and the tighter turning fighter has the advantage.)

The point to start the turn is based on the question "Can I make that corner?" When the answer is "Yes," start the turn. Initiate the lead turn when LOS movement increases "dramatically." During the turn, G should be adjusted as required to keep the adversary moving slightly forward along the horizon (horizontal turn). The objective is to roll out behind the adversary. The more turning room acquired, the longer the range for lead turn initiation and the lower the G-loading required to complete the maneuver. Conversely, if the maneuver is initiated at short range with little or no offset, a high-G turn is required to complete the maneuver.

Lead turns against a target that maneuvers prior to passing your 3/9 line do not produce a dead six position, but should still result in some turn advantage.

Lead turns can be accomplished in any plane. Assuming airspeed is near corner velocity, lead turns going down require slightly less offset than lead turns going up. A lead turn down is useful because it preserves airspeed. This is particularly effective if the adversary has a predictable flight path due to a low energy state. A lead turn up is effective because it allows visual contact with the bandit while possibly placing you in the bandit's blind zone. A lead turn coming from low to high takes great advantage of radial G during the terminal portion of the turn (when your lift vector is below the horizon). A good rule of thumb is to pull when the bandit can no longer be held at 30° high on the canopy without increasing G-loading.

The counter to a lead turn is to remove the offset *prior* to the lead point, i.e., take your share of turning room away by beginning your own lead turn.

Vertical Entry from Below. An entry from below (i.e., an Immelmann attack) is simply a low-to-high vertical lead turn. An advantage of this entry is the ability to acquire airspeed with an acceleration maneuver while also acquiring turning room. In addition, a vertical overshoot from low-to-high is easier to control while maintaining nose/tail separation with the bandit.

To prevent a large vertical heading crossing angle (HCA), maintain the target within the canopy bow (approximately 30° off the nose) during the acceleration.

After accelerating, start the pull to employ front aspect weapons or to maintain the bandit within the canopy bow. Converting 90° of aspect requires approximately 3000ft of turning room; for 180° of aspect, up to 9000ft of turning room depending on G-loading, entry airspeed, and altitude. Pull range is initiated for 90° of AA at approximately 10,000ft slant range. For a head-on pass, start the pull at 3nm. A good rule of thumb is to pull when the bandit can no longer be held at 30° high on the canopy without increasing G-loading.

During the maneuver, manage roll-out range and angle-off by varying G to control the bandit's rate of motion forward on the canopy. You may not have to point behind (lag) the bandit to do this. Relax Gs momentarily to drift toward the bandit's six, while maintaining lead or pure pursuit. The goal is to convert to 4000-7000ft behind the bandit with decreased aspect and angle-off with controllable overtake.

If you have a sufficient airspeed advantage, but do not acquire enough turning room to decrease all of the aspect, continue to pull and convert to a vertical position high inside the bandit's turn. Keep the bandit within 30° of the nose.

Vertical Entry from Above. An entry from above is simply a high-to-low vertical lead turn. An advantage of this entry is the ability to complete the maneuver at higher airspeed. A disadvantage is the defender can look up at the attacker, possibly enhancing his visual and radar acquisition. With insufficient turning room a high-to-low conversion may also result in a vertical overshoot. This is particularly critical when the target is at low altitude.

An important consideration for the entry from above is controlling airspeed to attain the desired nose position during the pull-down.

Common Errors for Vertical Entries:

1. Failure to attain sufficient turning room, generally due to a late decision.
2. Not having proper energy to both turn in the vertical and maintain adequate energy for subsequent maneuvering.
3. Improper control of nose position during the pull to maintain within the WEZ for the ordnance to be employed.

Air Combat Maneuvers (ACM)

ACM uses coordinated (two-ship) application of BFM to kill, defend, or separate from one or more bandits in a visual arena. ACM is the link between the intercept phase and the egress phase of the mission.

Objectives

1. Develop proficiency in two-ship coordinated maneuvering.
2. Teach specific engaged and supporting fighter roles in a visual fight.
3. Effectively integrate crew responsibilities to execute offensive and defensive tasks.
4. Develop enhanced situation awareness. An F-15E is capable of rapid kills from an offensive start. Consequently, the role of the supporting fighter is not the same when the engaged fighter is offensive as when he is defensive. This adjustment in priorities resulting from the other F-15E's positional advantage/disadvantage requires focused, concentrated training in the visual environment. There are four cornerstones to effective element employment: communications, formation integrity, flight discipline, and weapons employment.

Communications. Clear, concise communications are one cornerstone of efficient element employment. Every pilot must be able to use correct comm at correct moments in the fight. Proficiency in communications is gained only by daily application on every sortie. The time to start trying to improve your comm is not after the first "break right" call is made. The flight briefing should be a review of planned comm procedures, highlighting individual responsibilities and the words/phrases used to convey the most meaning as clearly as possible.

Full flight callsigns are mandatory. Do not assume your flight is the only one on that frequency. Random radio calls with no corresponding callsigns attached serve only to heighten the anxiety of all aircraft on frequency and, at worst, may cause disastrous consequences. Callsigns allow noninvolved flights to "tune out" your transmission while getting the attention of the people your message is intended for. When using the radio, a clear, controlled voice level requires you to have the words you need ready when you key the radio.

1. Directive and Informative Radio Transmissions. As part of a fighting team, you see situations develop quickly as you maneuver. As the bandit maneuvers you have to communicate what you see in the most efficient way. As the wingman, you may have to tell lead what to do if you have tally and he does not. If your information is not critical, your radio call should be informative

and lead will use it to make decisions while maintaining control of the flight. When the flight is definitely threatened, a directive transmission is called for.

a. Directive Transmissions. Directive radio transmissions must be prefaced by the callsign of the aircraft being addressed, i.e., "Eagle One, break right!" Directive transmissions assume not all flight members have the SA necessary to perform maneuvers required to defeat the threat. After making the "Eagle One, break right!" call, Eagle Two should first ensure Eagle One is doing what was directed. Next, an informative call describing why a break right is required helps Eagle One acquire a tally. The supporting fighter must continue to use directive transmissions until the engaged fighter calls tally and can begin to effectively defend for himself.

b. Informative Transmissions. Informative radio transmissions are normally prefaced by the callsign of the aircraft doing the talking. The most important of the informative transmissions is the bandit call, by which one aircraft attempts to get the other's eyes on the bandit. The bandit call has been standardized into the following format, which should always be used:

1. Callsign
2. Type aircraft, or bandit/bogey
3. Left or right (side of aircraft)
4. Clock position
5. High/low/level
6. Range
7. Amplifying remarks

2. Sample Radio Calls. Here is an example of a call in the above format: "Eagle Two, bandit, right, 3, low, 2 miles, going away." A modification of this format is used to follow up a directive call if your teammate is under attack. Here is an example: "Eagle One, break right. Bandit, right, 5, high, 9000 feet, closing!" In this case, the position of the bandit is described with respect to the airplane under attack so he can get a tally and counter the threat. Often, a descriptive radio call may be enhanced by including the word "continue" in the initial call, that tells all flight members no additional action is required. For example, "Eagle continue right, Two's tally one, right, 2, high, 4 miles."

Formation Integrity. In the ACM environment, formation integrity allows both fighters to maneuver in concert with mutual support. Maintaining formation integrity means the engaged fighter does his best to kill or defeat the bandit while the supporting fighter flies within a clear set of parameters, defined in relation to the engaged fighter's position. For example, lead may brief the supporting fighter to remain outside 2 nm of the bandit, but within 5nm. This helps establish parameters which ease the supporting fighter's visual/tally, as well as allow performance of other tasks. Flying within the specified parameters enhances mutual support since the engaged fighter knows where to expect the supporting fighter. Formation integrity is an integral part of all element maneuvering.

Flight Discipline. Flight discipline is the single most important factor in effective fighter employment. Maintaining flight discipline means flying your aircraft in accordance with clearly defined responsibilities and making decisions based on the flight lead's overall philosophy of employment. Obviously, pilots should NOT do anything to jeopardize their safety or the safety of their wingmen. However, changing or ignoring the flight lead's directions because you have a "better idea" is unacceptable. The flight must operate under one set of assumptions and guidance. Only the flight lead has the authority to change the plan. Maintaining flight discipline ensures the plan can be executed as envisioned by the flight lead.

Weapons Employment. Effective element employment is the ability to put weapons on target to kill. All the basics come together in that one moment where the decision to shoot or reposition is made. Valid weapons employment means understanding the capabilities and limitations of your ordnance. Applying BFM to take advantage of the capabilities and adjusting for weapon limitations results in kills. Even in the F-15E, cockpit switch errors consistently result in missed shot opportunities and wasted ordnance.

2v1 Offensive Visual Maneuvering. The visual phase of maneuvering is really the "meat of the mission" where ACM is concerned. The tactical intercept gets the element to the merge, usually in an offensive position. Once there, both fighters must work together in accomplishing the primary goal, which is to destroy the enemy ASAP, while maintaining mutual support. There must be complete understanding between the leader and wingman of their obligations to one another. This understanding forms the basis of the contract which governs two-ship visual maneuvering.

1. The Contract. Specific responsibilities must be assigned to each aircraft during the engagement in order to take advantage of element capabilities. These responsibilities serve two basic purposes: killing the bandit and ensuring element survival. Effective communication is vital to fulfilling each fighter's responsibilities.

   There can be only ONE engaged fighter (either offensive or defensive) at one time. Roles may rapidly change, several times, where the responsibilities must be definitively handed off and confirmed with radio calls and aircraft maneuvers.

   Engaged fighter responsibilities:

   a. Maneuver to kill the bandit (offensive) or negate the threat (defensive) in minimum time — fly best offensive/defensive BFM.

   b. Clear the supporting fighter to engage if he is in a position to shoot and the engaged fighter is safely outside the supporting fighter's weapons field of view (FOV) .

   c. Keep the supporting fighter informed of intentions, capabilities, future tactical plans, and if required, bandit position.

   Supporting fighter responsibilities:

   a. Maintain tally of the bandit and a visual on the engaged fighter.

   b. Clear for the element as the engaged fighter attacks.

   c. Maintain energy and a position from which to employ ordnance (if required), consistent with other priorities and without compromising the engaged fighter's safety. Do not become defensive.

   d. Engage other bandits and advise engaged fighter of additional threats.

   e. Direct defensive response as required.

   f. Maintain overall SA (situational awareness) to include area orientation, fuel, and separation opportunities.

The Flight Lead/Wingman Relationship. The previous discussion does not equate engaged and supporting roles with leader and wingman positions; this is intentional. Current F-15E tactics are designed to allow the best positioned fighter to engage. On defense, the choice obviously belongs to the bandit, since whomever he attacks is engaged. This, however, should not imply complete equality within the flight.

1. The flight lead still has the ultimate responsibility for mission accomplishment and flight survival.
2. He makes the decisions about whether or not to engage, what tactics will be used, and who will do the engaging or separating.
3. While the wingman is engaged, the flight lead supports him but retains the authority to direct the engagement, to terminate the engagement, to assume the engaged role, or to revert his wingman to the supporting role.

The engaged/supporting responsibilities work effectively in most 2v1 situations; however, when the contract breaks down, the flight may present a danger to itself. Confusion of roles is the most common problem. Two fighters, each thinking they are engaged, can easily end up occupying the same airspace; therefore, wingmen are only allowed to assume the engaged role on attack when cleared by the flight lead. This avoids confusion about responsibilities. If the tactics are being well executed, the leader should have to make very few inputs; when SA or proper execution break down, he must take firm, directive control of the flight to ensure safe mission accomplishment.

Offensive Maneuvering. The termination of the intercept phase is when the engaged fighter visually acquires and maneuvers against the bandit. If the bandit detects your attack and maneuvers against you, the tactical wingman may be in a better position to engage by virtue of turning room or because the bandit is actively attacking him. As soon as possible, designate one engaged and one supporting fighter. That occurs when one fighter calls "Eagle One engaged, MiG-21, left, 10, low, 2 miles."

1. Engaged Fighter. This fighter's maneuvering is simply his best 1v1 BFM to kill the bandit. He should maneuver as aggressively as if he had no wingman, and should not rely on his wingman to get him out of trouble. If the bandit cannot be killed immediately, press the attack to remain offensive and force the bandit to react defensively until your supporting fighter is able to maneuver for an entry or shot. When informed that the supporting fighter has an entry opportunity or is engaging, maneuver to set up the supporting position, clear the supporting fighter to engage, and assume the supporting fighter responsibilities. If unable to do so, then so state and ensure the supporting fighter acknowledges, thus clarifying that he is still the supporting fighter.

2. Supporting Fighter. The supporting fighter must gain or maintain turning room for an entry to the fight and pick up supporting fighter responsibilities; maintaining/obtaining visual/tally and clearing the area. The bandit may either break away from the supporting fighter or into him.

3. Fight Entries. The supporting fighter may need to engage the bandit in several situations. Generally, these can be classified into two cases: (1) When the engaged fighter becomes defensive, and (2) When the engaged fighter is in a fight that may take a long time to resolve.

   When an F-15E is engaged with an offensive position of advantage, the supporting fighter should not be primarily concerned with entering a fight that will soon be over. When the engaged fighter is defensive, the supporting fighter should place primary emphasis on entering the fight and killing the bandit. Flying the supporting fighter profiles described above places you in an excellent position for entry.

4. Engaging Other Threats. The supporting fighter's job is to keep the engaged fighter free to kill the bandit. In part, this means killing any bandit who may become a factor to the fight. Often, the supporting fighter gets a tally on another bandit looking for an entry on the engaged fighter. The supporting fighter must engage this new threat and quickly kill it before the engaged fighter is forced to react. Radar contacts *may* present a threat as well. These contacts must be analyzed in terms of their range and aspect in relation to the fight. Normally, split criteria are briefed to give the supporting fighter a decision-making aid on whether to engage this new threat or monitor/drop it.

5. Supporting Fighter Positions. The supporting fighter's position must allow fulfillment of responsibilities as listed above. In addition, he must be able to assume engaged fighter responsibilities if the situation dictates. In relation to the fight, the supporting fighter should strive to stay between 2nm and 5nm away until ready to engage. This range window keeps the supporting fighter far enough away to deny the bandit a shot opportunity while allowing relatively easy tally/visual. In addition, his flight path should keep the fight between seven and ten o'clock or two and five o'clock. Do not allow the fight to drift to six o'clock or you will quickly extend beyond visual range. Pointing at the fight is only good for ordnance employment or entry into the merge when cleared by the engaged fighter.

6. Areas to Avoid. The supporting fighter must avoid three areas: directly above, directly below, and within 2nm of the fight while trying to look for an entry.

Flying directly above the fight forces the supporting fighter to focus attention on the fight geometry instead of clearing the area for other bandits. If an entry is attempted, the supporting fighter must fit the turn into an already tight and, most likely, slow turning fight. Although possible, this maneuver is very difficult and often results in an overshoot because of the inability to slow down enough in a very nose low attitude.

Entering directly from below the fight has many of the same problems. Trying to enter the fight from within 2nm should be avoided as well. Inside 12,000 feet, the supporting fighter may not have the required turning room and G available to employ ordnance. This causes (at best) rushed shots and (at worst) missed opportunities to engage. Nominally, this is caused by the differences in energy between the bandit and the supporting fighter. More distance allows the supporting fighter time to predict an entry and react to the situation.

Flying inside 12,000 feet may also allow the bandit opportunities to pause and employ ordnance against you while the engaged fighter is maneuvering.

2vl Defensive Visual Maneuvering Considerations

1. When the flight finds itself under attack, the obvious concern is survival (negating the bandit's initial attack). Because seconds are critically important, the flight must have some preplanned initial moves — actions that they are very familiar with and have thoroughly practiced.

2. Once the initial attack has been negated, the immediate concern of the flight should be to separate or go offensive. Reestablish visual and positional support and maintain tally on the bandit to be sure you are out of range. If the separation is not going to achieve sufficient range, the element needs to continue defensive maneuvering to deny the bandit weapons parameters. The element should use chaff/flares as appropriate.

3. If it is apparent from the beginning that the flight cannot separate, the object should be to sandwich the bandit for a kill or to force a separation. Engaged and supporting fighter tactics are now in order. In this case, however, the bandit determines who is engaged (the one attacked); the other fighter then maneuvers to bring ordnance to bear.

4. Once the roles have been established, conduct of the engagement is conceptually straightforward (though often physically difficult). Just as on the offense, the engaged fighter must perform his best 1v1 defensive maneuver-

ing, this time to negate the attack. The supporting fighter should predict the bandit's flight path and maneuver for a shot. The engaged fighter must fight his best defensive fight; the supporting fighter may not succeed in his attack (or may come under attack himself). The supporting fighter, in addition to keeping visual/tally and predicting flight paths, must be concerned with conducting a quality attack and getting a good quick shot. Do not assume that the bandit sees the supporting fighter or any missiles fired. A bad shot may not pull him off his attack. Do not take shots that put your wingman at risk, i.e., in the missile's FOV. Coordination between the fighters is essential; it increases each other's overall situation awareness. Information from the engaged fighter about where he intends to take the fight help the supporting fighter better predict flight path geometry.

5. If both fighters are tally, but blind, it is imperative that roles be established. Positive communication and effective maneuvering must be accomplished by both fighters to ensure friendly flight path deconfliction. The flight lead is ultimately responsible for establishing these roles, element survival, and training rule compliance. References off the bandit and/or separate altitudes to ensure deconfliction help both fighters achieve the visual while increasing SA.

   The following is a communication example where Eagle Two is engaged defensive and Eagle One is supporting from an offensive posture:

   Eagle 2 "Eagle Two defensive, tally one, blind."

   Eagle 1 "Roger, Eagle One tally one, blind, offensive 1 mile behind the bandit. Eagle One will stay high."

   Eagle 2 "Eagle Two is passing the bandit low, left to left, now."

   Eagle 1 "Eagle One, visual, your left ten o'clock high."

   Eagle 2 "Eagle Two, visual."

   Eagle 1 "Roger, Fox 2, kill, bugout South."

   Note: Specific verbiage may vary as roles/situations dictate.

Initial Moves. The basis of successful two-ship defense is a system of well thought out initial moves. The moves must effectively negate the initial attack. They must be aggressive and designed to rotate the vulnerable cones away from the threat. There is no room for error, so initial moves must be simple and easy to remember. Lastly, initial moves must become almost second nature; only practice helps there. The main principles to follow in accomplishing initial moves when the bandit is sighted in the aft quadrant approaching missile range are:

1. When defensive, avoid putting both aircraft in the same area at the same time. When possible, split the element laterally and vertically.
2. The aircrew with the tally should:
   a. Start a hard/break turn into the bandit.
   b. Call the flight left or right.
   c. Dispense chaff and flares.
   d. Put lift vector on the bandit and pull.

   Note: The first three items should be accomplished simultaneously.
3. The aircrew without a tally should:
   a. Turn in the direction called.
   b. Dispense chaff and flares.
   c. Pull maximum Gs.
   d. Attempt to acquire a tally.
4. The difference between a hard and break turn is power selection and G-loading. In both cases, turn the aircraft to rotate your vulnerable cone while bringing the threat to your nose. A hard turn should be called for if a bandit has not reached weapons parameters but is maneuvering for a shot. Max AB in a hard turn assures maximum energy in the turn and after roll-out facing the threat. If the bandit is in position to shoot or has taken a shot, a break turn in MIL power or less while dispensing chaff and flares offers the best defense. Afterburner should be selected as soon as the bandit's nose is no longer in position to shoot, or he is outside valid parameters. If it is evident that the bandit intends to pursue the attack, stores jettison may be appropriate, if so configured.

Intercepts

An intercept is the means by which a fighter aircraft maneuvers from beyond visual range to a position to employ ordnance, visually identify the target, and/or enter the visual fight arena. The intercept can be flown using GCI/AWACS information, on-board radar information, or a combination of the two.

Prior to initiating any intercept, consider the mission, threat, environment, weapons load, ROE (rules of engagement), available support assets, and the proficiency of individual flight members.

Intercept Types

There are two basic types of intercepts, and a variation which combines the elements of both. First is the cutoff or collision course intercept. This is generally used where minimum time to kill is desired. The other is the stern conversion, used when other limitations preclude a cutoff or identification may be required. The two together form the front-stern reattack where turning room is maintained or developed to allow a stern conversion should the AIM-7 attack fail or there is a requirement to convert on the bandit.

Cutoff/Collision Course Intercept. The cutoff or collision course intercept is the quickest course to weapons employment and is also the simplest of all intercepts. To fly a collision course intercept, determine the CATA (collision antenna train angle). The formula for a co-speed CATA is listed below. Turn to place the target on the CATA.

180° - Aspect angle = CATA

Stern Conversion. The objective of a stern conversion is to develop and maintain turning room and close to a VID (visual identification) and/or firing position. There are three types of stern conversions: horizontal, combination, and vertical.

1. Horizontal Intercept. The horizontal intercept is flown nearly level with the target and offers some advantages. Since the intercept is basically two-dimensional, it is easier to track a target with no lock-on, and is easier to fly during night or IMC (instrument meteorological conditions) conditions. However, there some disadvantages. The fighter is easier to see and defeat because he is level with the target. Also, the horizontal intercept requires a lot of turning room (8-10nm).

2. Combination Intercept. Combination intercepts gain turning room in both the horizontal and vertical and can be thought of as either the chandelle or the slice. Unlike the horizontal intercept, the combination gets the fighter away from the target's horizon and is therefore harder to see and to counter. The main disadvantage is that night or IMC combination intercepts may not be practical due to the maneuvering required (5-10,000 feet of vertical turning room).

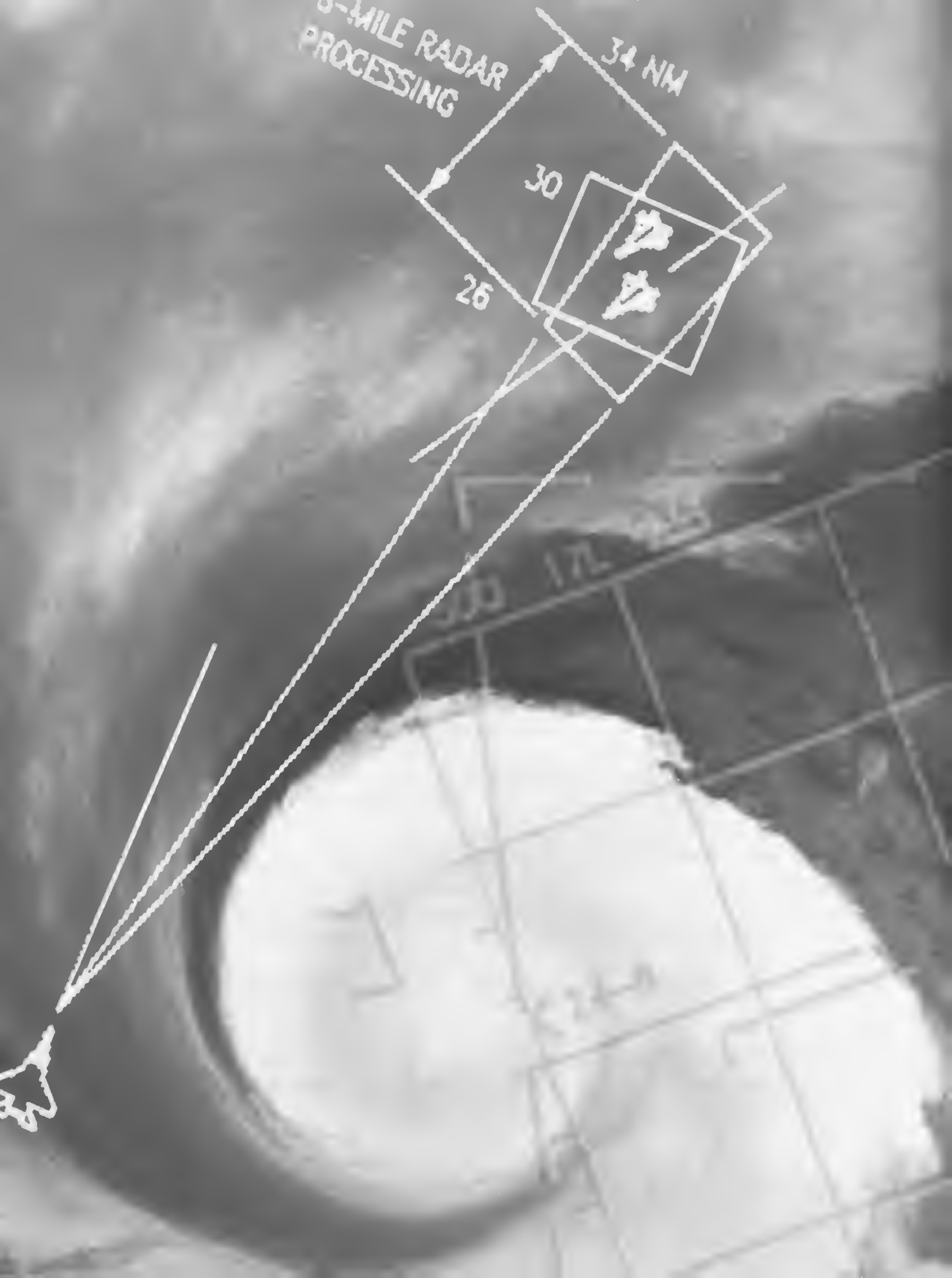
3. Vertical Intercept. There are two types of vertical intercepts: low to high and high to low. A key advantage to the vertical intercept is that it is very hard to be seen by the target. Additionally, attacking from high allows entering the fight with maximum energy advantage, while attacking from below may mask your aircraft from the target's radar. The disadvantages are: difficult to get a tally looking high to low, potential square corner (high to low), energy is easily depleted on a low to high (negative Vc (velocity of closure)), and it is very difficult to fly no lock-on. The parameters are: more than 10,000 feet vertical offset, early tally (8-10nm), pure pursuit conversion at 30° antenna elevation/depression, and a rollout within 9000ft with 50 to 100 knots Vc.

   During the vertical intercept, increase aspect to as close to a pure 180 as possible and achieve the desired vertical offset. At a minimum, fly the CATA until reaching 30° elevation/depression, then pure pursuit. On a high to low, power is modulated to control energy at roll-out. On a low to high, throttles are in afterburner, maintaining energy.

Intercept Summary

There are two basic types of intercepts: cutoff/collision course intercept, and stern conversion. The collision course intercept is the easier of the two but it also makes up a portion of each stern conversion. The table on the next page summarizes the three types of stern conversions flown.

Aspect Angle	Intercept Geometry	Altitude Differential	Pure Pursuit
Horizontal			
H-16	*Put target cold to build turning room 40-50*	*Deconflict ±2000 ft*	*20nm & 15 AA 15nm & 14 AA 10-12nm & 13 AA*
15-12	*CATA to maintain turning room or hot to increase AA*	*Deconflict ±2000 ft*	*20nm & 15 AA 15nm & 14 AA 10-12nm & 13-12 AA*
11-7	*Put target 50-55 hot to gain closure*	*Deconflict ±2000 ft*	*5-10nm*
6-T	*1/2 AA hot*	*Deconflict*	*5nm*
Combination			
H-16	*Put target on CATA or cold to build turning room 30-50*	*5-10,000 feet*	*20nm & 16 AA 15 run & 15 AA 10nm & 14 AA*
15-12	*CATA to maintain turning room or hot to increase AA*	*5-10,000 feet*	*15nm & 15 AA 10-12nm & 14 AA*
11-7	*Put target 50-55 hot to gain closure*	*5-10,000 feet*	*5-10nm*
6-T	*1/2 AA, hot side*	*5-10,000 feet*	*5nm*
Vertical			
H-16	*CATA/increase AA to H*	*10-15,000 feet*	*30° antenna elevation*
15-12	*CATA to conversion point*	*10-15,000 feet*	*30° antenna elevation*
11-7	*Put target 50-55 hot to gain closure*	*10-15,000 feet*	*5-10nm and 30° antenna elevation*


MILE RADAR
PROCESSING
34 NM
30
26

AIR-TO-GROUND COMBAT

TIPS ON USING A/G WEAPONS

Strike missions are the F-15E's reason for being. So, it stands to reason that in order to succeed in F-15 missions, you can't know enough about when to load and how to use all types of air-ground ordnance that the F-15E carries. To this end, this section provides a compilation of tips for using weapons and bombing modes, which we've gathered from playtesters and our own experience.

Quick Index of Weapon Information

You'll find information on air-to-ground weapons everywhere in this book.

- **Tips.** If you want tips on effectively using your weapons, look no further — **Tips on Using A/G Weapons** has advice gathered from playtesters.
- **Step-by-step instructions.** If you're still learning to use these weapons, see the step-by-step instructions in the *Expert Flight Manual* on pp. 4.62-69.
- **Flythroughs.** You will find detailed flythroughs of the game's three air-to-ground training missions — A/G Strafing, Guided Munitions and Unguided Munitions — on pp. 22-27 of the **Training Missions** chapter. See also **Mission Types**, pp. 46-97.
- **Loadout advice.** The game's *Arming* screen has a Weapon Advisor function, which tells you which weapons work best against different target. This info is summarized in **Weapon Advisor**, p. 209. **Combat: Engaging** (*Expert Flight Manual*, pp. 4.62-69) also discusses weapon selection considerations.
- **Technical info.** Jane's entries for these weapons have more technical information (full entries and 3-D views are available from the game's *Reference* screen; for abridged entries and diagrams, see **Jane's Specifications**, p. 262).
- **Game stats.** See **Weapons**, p. 224, for stats on all A/G ordnance.
- **Delivery type information.** The **3-3 Excerpts: Air-to-Ground** section (pp. 176-195) of the **Air-to-Ground Combat** chapter gives real-world information on A/G combat deliveries used by F-15E pilots.

Air-to-Ground Missiles

The only air-to-ground missiles in the game are the AGM-65D/G Mavericks.

AGM-65 Maverick

- Although the AGM-65 doesn't boast a very powerful warhead, it is ideal for striking tanks and small buildings, especially if you don't want to damage adjacent objects.

- The game lets you choose between D- and G-models. You can carry up to six AGM-65Ds (lighter warheads) or two AGM-65Gs (heavier warheads). The D-model is good for standoff, precision attacks against vehicles, SAMs, AAA and small ships. The G-model is capable of the same, and it has a larger warhead that allows it to destroy larger targets.

- AGM-65Gs are a bit more rare in the game's campaigns due to their sheer size and cost per unit. However, a single AGM-65G can take out a small building — it has roughly the same explosive power as a Mk 82.

- By default, the AGM-65s are set to Auto mode, in which the seeker head will automatically lock on to a target when you designate one. If you switch to Man (manual) mode (by pressing PB 6 on the Weapon Video MPD page), you can use the IR video to center the missile optically on the target. This is more difficult, however.

  With all guided weapons, it can be useful to reprogram your right MPDs in A/G master mode based on weapons you use the most. For instance, you can preset the right MPD to default to the Weapon Video MPD instead of the A/G Arm MPD. (Many playtesters recommend this.) See **6. Master Mode Programming** on p. 2.37 of the *Expert Flight Manual.*

- When you select Mavericks, you normally select a single pylon. If you fire off several missiles in succession, they all launch from the pylon you've selected. Once it's empty, you must then select the other AGM pylon in the Weapon MPD. To avoid having to pause and do this, you can select both AGM push-buttons at once. Now, you won't have to pause to activate the other pylon once you run out of missiles on the first pylon.

Air-to-Ground Bombs

In order to successfully release any bomb, you must successfully complete two tasks (in addition to simply staying alive, of course). Your first task is to steer your aircraft so that you keep to a direct path over your target. Your second task is to release the weapons at the right time so that they fall on the target. Guided bombs that are steered after launch (i.e., Paveways and, if you are using a datalink pod, GBU-15s) can correct for small errors made in either task, but since the bombs have no propulsion system, corrections are limited.

Bombing Modes

Bombing modes control how the HUD presents the information you need to complete your two tasks. Three different bombing modes are available. All three have their advantages and disadvantages, which are discussed below.

Note: *When you're in A/G master mode, the current bombing mode is listed in the lower right corner of the HUD. PB 5 of the A/G Arm MPD page cycles through modes.*

CDIP

- The default bombing mode — CDIP — often isn't the best one. CDIP bombing mode draws a line on the HUD from the velocity vector on your HUD down to the point on the ground where the weapon will impact. The point of impact is marked by a large reticle — you drop the weapon when the reticle is centered over the target.

  A problem arises if you are flying at a low altitude or flying slow — the weapon impact point is now closer to your aircraft, and the reticle disappears below the HUD field of view. You can't make an accurate drop if you can't see the reticle.

- At low altitudes and low speeds, you are forced to make a dive-bomb attack on a target. Dive-bombing at low altitudes isn't recommended — the most common mistake made using CDIP mode is diving, then pulling up too late.

- At high speeds and with enough altitude, you can use CDIP mode for a nearly level delivery.

- CDIP can be inaccurate over uneven terrain because it uses the aircraft's current altitude to determine the altitude of the target.

Auto

- In Auto bombing mode a long, vertical line (ASL) extends up from the target. You simply center this line on the HUD to align for an accurate pass over the target. You should be able to see the ASL even when the target is beneath you.
- The weapons system controls when the weapon is released, so you can concentrate on steering and dropping countermeasures. When the TREL count (lower right corner of HUD) reaches 5 seconds, pickle (i.e., press and hold joystick button 2). Hold the pickle button down, and the weapon is automatically released when TREL reaches zero.
- Auto bombing mode can save you from yourself — if you've steered more than 20° to the left or right of your target, you won't be able to release a weapon.
- Auto is the best bombing mode for making level deliveries at 10,000ft or so, but you can go higher or lower. Keep in mind that the higher your altitude, the more margin there is for error.

Auto Loft

- Auto Loft mode is best applied to low-level bombing runs. You can come in low (hopefully undetected), but pull up sharply before launch. Pulling up, or "lofting" the bomb, gives it greater range than it would have if dropped from level flight and removes you from the blast radius of the weapon.
- Mastering this mode is more difficult than the other two because:
  1. You have to fly precariously close to the ground. SAMs aren't a threat, but AAA and unexpected terrain features are.
  2. At high speeds and low altitudes, the time for finding and lining up with your target greatly diminishes.
  3. You must pull up at precisely the right instant. Time-to-pull (TPULL) appears in the lower right of the HUD when you are in Auto Loft bombing mode. As soon as TPULL reaches zero, pull up. A horizontal line appears on the HUD to indicate how far — pull until it is centered on the velocity vector.
- Pickle after you start pulling up. As with Auto bombing mode, the weapon is released automatically if you keep the button pressed until TREL reaches zero.

Release Mode Hints

- Auto and Auto Loft release modes are blind, meaning that you often can't see the weapon's impact point or the target at the moment of release. In both modes, you must fly straight prior to releasing the weapon.
- In Auto mode, once you are aligned you can use autopilot to maintain your heading and altitude. Make sure your wings are level, and press [A]. Then maintain your altitude and press PB 9 on the UFC to get the Autopilot (A/P) submenu. Click PB 5 (ALT HOLD). The autopilot will now maintain both your heading and altitude. (Watch out for obstacles if you're flying low, though.)
- In Auto Loft mode, watch the TPUL number (time to pull-out) number on the HUD. When it reaches zero, pull the nose up. Make sure, however, that you don't inadvertently bank the plane while you're doing this. If you do, the weapon will loft wide of the target. Keep the pull-up steady, and when TREL (time-to-release) reaches five seconds, press the pickle button and hold it down until the timer counts down to zero and all weapons release.
- In CDIP mode, start a gentle dive from 10,000 to 15,000 feet of altitude, and about 10nm away from the target. Don't angle down further than 45 degrees, or you'll have trouble pulling up.
- In CDIP mode, the horizontal line that slides up and down the DIL indicates the edge of the frag envelope. At high altitudes, this isn't very important. During low-level runs, however, make sure that this line is below the velocity vector. Otherwise, your aircraft may get caught in the blast.

Dumb Bombs

Dumb (unguided) bombs may not be as accurate as their guided cousins, but they are plentiful and fairly simple to use. You have a number of dumb bombs at your disposal in *F-15E*. They can be divided into several types.

General Purpose, Low-Drag Bombs

- The Mk 82 and Mk 84 bombs are both unguided, general purpose bombs. They can be dropped from any altitude, although inaccuracies increase at higher altitudes.
- Mk 82 and Mk 84 bombs are not especially effective against hardened targets, but they're suitable for most other targets.

Cluster Bombs

- A cluster bomb looks like a normal bomb, but acts differently when it detonates. Instead of impacting the ground, a CBU explodes at some predetermined height above the surface and separates into smaller bomblets. These bomblets can be incendiary (fire-starting) or fragmentary (explosive) and detonate upon impact with the ground. In the game, you can use the A/G Arming screen to set the altitude at which detonation occurs.
- CBU bombs with fragmentation bomblets are intended for wide-area attacks against soft targets, including troops, tents, grounded aircraft and other unarmored targets. Many different versions of CBU bombs are available. The CBU-52, -58 and -71 carry fragmentation bomblets, while the "A" models of the CBU-58 and -71 carry incendiary bomblets.
- The CBU-87 carries fragmentation bomblets as well, but each has a small parachute which retards their flight. The CBU-97 bomblets have parachutes, as well as small, individual IR-guided warheads.
- The Mk 20 Rockeye II is a cluster bomb, despite its moniker. It was the first bomb of this type and is especially effective against tanks.

Runway Bombs

- You can use any high-powered bomb to crater a runway or taxiway. However, the BLU-107 Durandal is specifically designed for penetrating this type of surface. Its 15kg HE warhead imbeds itself over 10 feet underground, then detonation occurs. This explosion below the surface causes much more destruction than a normal surface explosion and takes more time to repair.
- In the real world, detonation can be delayed by minutes, or even hours. In the game, detonation occurs several moments after impact.

High-Drag Bombs

- During low-altitude bombing, a bomb blast can pose danger to the attacking aircraft. High-drag bombs attempt to solve this problem by attaching small retard parachutes to the bomb, slowing its forward momentum and descent rate. The aircraft can then safely pull up or speed away without getting caught in the explosion.
- The BSU-49 (Mk 82 AIR) is basically a Mk 82 fitted with a retard parachute, while the BSU-50 (Mk 84 AIR) is a Mk 84 with a similar parachute. Both are intended for low-altitude bombing runs.

Guided Bombs

It's a bit more difficult to score a hit with a guided bomb. *F-15* features two main types of guided bombs — TV-guided GBU-15s and laser-guided Paveways.

GBU-15 (TV- or IRTV-Guided)

- You can only carry two of these, but they pack a punch and almost always hit their mark if you drop them correctly.
- In fact, the biggest problem with GBU-15s is that they're in limited supply in the game's campaigns. You'll probably want to conserve them for bombing runs against a single, specific target.
- Within the GBU-15 family, there are four models:
  - *GBU-15(V)-1* A Mk 84 warhead with a TV camera for guidance
  - *GBU-15(V)-2* Same as -1, with an IR camera to allow night use
  - *GBU-15(V)-31* A penetrator BLU-109 warhead with a TV camera
  - *GBU-15(V)-32* Same as -31, except that it has an IR camera
- Use the -1 and -2 against non-hardened targets or in areas where you want to invoke a lot of collateral damage. Use the -31 and -32 against hardened targets.
- All can be used during daylight hours, but only the -2 and -32 can be dropped at night.

Dropping a GBU-15

- Aiming a GBU-15 is much like aiming an AGM-65 missile, as long as you're using the Auto launch mode (as with the AGM-65, this is the default mode). When you designate an air-to-ground target, the weapon's seeker head will automatically be aimed at this target. Weapon video from a camera in the missile's nose is displayed in the Weapon Video MPD.
- Pickle the bomb (i.e., press button 2 on the joystick) when the target is inside the min/max range timers on the right side of the Weapon Video MPD or any-time *after* TREL has expired on the HUD.

- Again, as with the AGM-65, you can press PB 5 (Manual) if you want to manually aim the weapon at the target before launch.
- However, the GBU-15 has an added feature which you can use if you load an AN/AXQ-14 (this is a two-way datalink pod, which is different from the AN/AAQ-14 targeting pod). This pod allows to steer the weapon after launch (using the video images on the Weapon Video page to see where it's headed) for maximum accuracy.

  This can be fun, but it's extremely difficult to do when you're also trying to pilot the plane and avoid AAA fire. (For instructions, see the *Expert Flight Manual*, p. 4.67).
- A good trick for dropping GBU-15s is to remain in Auto mode until after the camera head snaps to target. Then, make the switch to Manual mode and sweeten the missile's aim by using the arrow pushbuttons on the Weapon Video MPD to center camera (and thus the nose of the missile) on the target. Remember, you must activate tracking (TRK) and switch to TERM mode for the bomb to guide towards the target.
- If you're using Manual launch mode, you'll really want to take advantage of the pause feature. That way, you manipulate MPD information while the world around you is paused.
- The Weapon Video MPD functions with weapons that have video cameras (GBU-15s and the AGM-65D Mavericks). It gives you a pre-launch view of the weapon's target. Simply left-click the arrow pushbuttons to maneuver the camera view, then left-click the TRK pushbutton. (See the *Expert Flight Manual*, p. 4.66, for details.)

Laser-Guided Bombs (aka Paveways)

GBU-10 (Mk 84 warhead)
GBU-10E Paveway II (Mk 84 warhead)
GBU-10G Paveway II (BLU-109 warhead)

- You can carry up to five GBU-10Es for a short-range bombing run against smaller targets. However, E-models incur a lot of drag if you're playing in Expert mode.
- The GBU-10G features a BLU penetrator warhead, making it an ideal choice for runway destruction.

GBU-12 Paveway I (Mk 82 warhead)
GBU-12D Paveway II (Mk 82 warhead)

- Two versions of this bomb exists — the GBU-12 Paveway I and GBU-12D Paveway II. You can carry up to eight of either bomb.
- Neither bomb can take out a runway, but both are effective against small, clustered targets and tanks. (You must hit targets head on to destroy them, but with laser guidance, this isn't too difficult.) If skillfully used, GBU-12/Ds can be as effective as Mavericks — but much less expensive.
- GBU-12s are sometimes referred to as "tank-plinking" bombs.

GBU-24 Paveway III (Mk 84 warhead)
GBU-24D Paveway III (BLU-109 warhead)

- The GBU-24 and GBU-24A have a larger warhead than the -12. The GBU-24D features a penetrating warhead that can puncture hardened targets.
- You can carry three GBU-24s (any model) — one under each wing, and one on the centerline pod.

GBU-28 (BLU-113 warhead)

- This is the most feared bomb in the GBU family, but unfortunately, you can only carry two of them on your aircraft. Known as a "Super Bunker Buster," it has a penetrating warhead and intense explosive power.

Dropping Laser-Guided Bombs

- When dropping a laser-guided bomb, you steer your aircraft into the target area and release on the WSO's cue, as you would with unguided bombs. After release, however, you must activate the laser to guide them.

  The first rule to live by then, is — *don't forget to load the AN/AAQ-14 targeting pod, which houses the laser designator.* Without it, your valuable Paveways won't be anything more than expensive dumb bombs.

- GBU bombs don't have propellant systems, so you need to give them momentum and room to maneuver. You can make a comfortable launch if you have around 20,000 feet of altitude and an airspeed between 400 and 500 knots.
- You'll probably find it easier to keep a level flight delivery if you use Auto bombing mode (press PB 5 on the A/G Arm page until it says AUTO.)
- In Auto bombing mode, remember to keep an eye on the time-to-release (TREL) in the lower right corner of the HUD. Press the pickle button (weapon firing button) down when TREL reaches 5 seconds and hold it until TREL reaches zero. (If you've selected more than one bomb for release, keep the button pressed until TREL for the final weapon reaches zero.)
- ***Don't*** *activate the laser before you drop the bomb.* After you release the bomb(s), time-to-target (TGT) replaces the time-to-release (TREL) on the HUD.
- Be careful not to activate the laser too early. The laser-seeker mechanism in the nose of a Paveway "guides" the weapon by steering the weapon so that its trajectory is aligned with the laser beam. Since the laser beam is a straight line, and the natural trajectory of a bomb is an arc, if you activate the laser too early, the Paveway ends up correcting and recorrecting it's flight path multiple times. These multiple corrections cause it to travel farther than necessary, and it usually falls short of the target.

- Watch what you're doing while you're lasing the target. One drawback to using laser-guided bombs is that you can't make a sharp maneuver to avoid SAMs or AAA fire while lasing the target. If you do so, you risk *masking* the laser — putting part of your plane or a terrain feature between the laser and the target you are lasing. If you do this, the bomb basically becomes an unguided weapon, following a free-fall trajectory that usually ends up hitting long.
- De-activate the laser after impact.
- When you pull up the Target IR MPD page in order to activate the laser, you may discover that your designation was a little off. Fear not — you can use the Target IR camera to fine-tune your target designation:
  - To get a better view of the target, use PB 7 to cycle through field-of-view options — WFOV (wide field of view), NFOV (narrow field of view), and ENFOV (enhanced field of view). WFOV covers the largest area, ENFOV gives you the maximum magnification.
  - Click PB 10 (TRK) to deselect/unbox the tracking option. When TRK is deselected you can move the camera about freely.
  - Use the arrow pushbuttons (pbs 3, 8, 13 and 18) to center the tracking gate over the target. Click TRK again to snap the camera to the target. Now, whenever you maneuver, the camera will move to keep this target in sight. (As long as you keep the target where the Target IR can swivel to it, of course.)
  - Click PB 1 (CDES) until CDES is boxed/selected. This redesignates the point in the center of the tracking gate as your target. (If CDES was already boxed, then the target was automatically redesignated when you clicked the TRK PB.)
- Buildings are more difficult to crack if they're hardened. The penetrator versions of the GBU (the -10G and the -2 and -32 models of the GBU-15 and GBU-24 A) work best against these targets. First, they pierce the target's outer concrete and make a nice, neat hole. Once past the concrete, they detonate. You can easily destroy a single, hardened target this way, but you won't score any collateral damage. Non-penetrator GBUs are not especially effective against hardened targets.

3-3 EXCERPTS: AIR-TO-GROUND

A thorough understanding of all available weaponry is an integral prerequisite to a successful mission, but it isn't the only thing you need to know. An F-15E pilot must be aware of all the factors that can come into play during a bombing run. The following excerpts from the USAF 3-3 manual provide factual information important in air-to-surface missions, as well as elements that need to be considered in the preparation stage.

All material in this section appears thanks to the United States Air Force (ACCM/PACAFW USAF EW 3-3, Volume XVII, published 1 June 1994). Chapter numbers and headings correspond to the numbers used in that manual.

Introduction

Surface attack is the primary mission of the F-15E. With its long range, ordnance carriage capability, night/IMC low-level capability, the F-15E is the most capable, flexible, and lethal long-range interdiction weapons system in the world. This chapter presents the fundamentals of surface attack planning and execution, as they relate to two employment arenas: the controlled range and the uncontrolled range or battlefield, conducting tactical employment with live weapons.

Items common to all surface attack sorties include:

1. **Desired mission objectives**
2. **Threats**
3. **Weather**
4. **Terrain**
5. **Ordnance load**
6. **Weapons employment data***
7. **Tactical deception**
8. **Formations**
9. **Fuel**
10. **Communications**
11. **Support forces**

* Including weather/IR detection range and systems back-ups.

Controlled Range: F-15E Delivery Options

Auto Mode

Auto is the primary delivery mode used in the F-15E. The target is designated using any of a variety of techniques, and the avionics system provides steering to the aircrew to the computed release point.

Because the CC computes bomb range and compares it to designated target range continuously, the pilot has complete use of the vertical for maneuvering. Using the radar and LANTIRN target pod, the Auto mode is extremely accurate, and the HUD symbology presentation makes this mode very flexible for several different release options.

Factors Affecting Auto Mode Accuracy

Five factors affect the accuracy of an Auto delivery. They are the accuracy of the designation, the accuracy of the height above target computation, system drift (affects patch map quality), ballistic errors, and crew errors.

Designation accuracy is directly affected by the fidelity of the HRM patch map. "Squint angle" is a term used to describe the relative doppler velocity of the object being mapped as the aircraft flies along its track. The greater the doppler shift, the more accurate the designation from the map due to the decreased effect of small velocity errors. It is important to understand a map with good resolution may still have poor designation accuracy if it was taken close to the aircraft's nose or if velocity errors exist. Therefore, always attempt to take maps for designations and updates with high offset (at least 30° off the nose), high velocity (400+ KCAS), and short range.

All Auto deliveries require a target designation. In increasing order of accuracy, the target can be designated via HUD, A/G radar, or the LANTIRN Target pod. The target IR pod designation is normally the most accurate available. The ability to visually ID the target, obtain precise laser ranging for release computations, and provide laser guidance for precision munitions are all advantages of the target pod which make a designation using this source the most desirable.

Auto Delivery Types

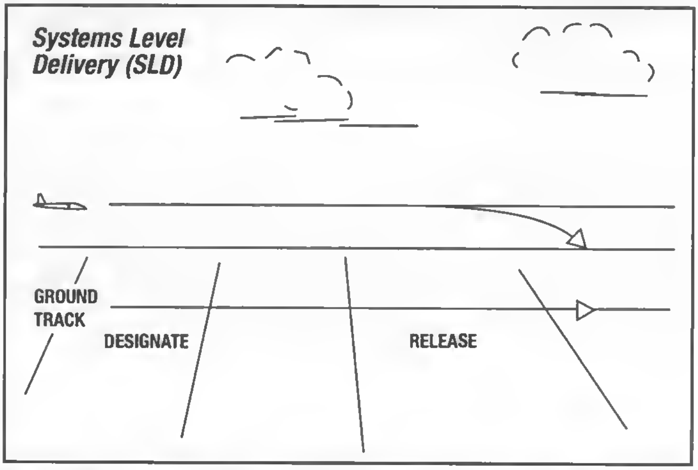
The basic Auto deliveries — systems level, loft, and systems deliveries — are described in this section. Included are techniques to improve accuracy and crew coordination.

Systems Level Deliveries (SLD)

A level attack profile provides an accurate means to deliver ordnance in all types of weather. It is flown from the radar pattern on the controlled range. The figure below is a depiction of the SLD profile. The approach to the target is from any altitude or direction. The attack steering is based on present position direct to the target or via a crew-selected attack heading if pattern steering is designated. Once the target is designated, command heading on the HUD and HSI is the heading to fly to reach the wind-corrected release point.

The primary task in tracking to the target is to keep the ASL centered. At 15 seconds TREL, the radar automatically initiates AGR, if Auto is selected as the priority sensor (no laser ranging available). This is the pilot's signal to concentrate on keeping the velocity vector on the ASL and to stabilize airspeed and altitude parameters.

The pickle button may be depressed any time after the target is designated, but you may want to wait until you are at the desired release altitude with 5-10 seconds TREL. After release, fly the safe escape maneuver used in planning the delivery. Failure to do so may result in frag damage.



Loft Delivery

Loft is a low-altitude climbing delivery employed to achieve stand-off range with low-drag weapons. After bomb release, a hard descending turn is accomplished to get back to the low altitude arena and avoid overflight of the target and weapon frag. The target may be designated by any means. Once A/G master mode is selected, the HUD displays TPULL for the selected release angle with 5° or more set for loft angle. Upon designation, the CC begins computing bomb range and range to the target, and displays attack steering.

The approach to the target is made at low altitude on final attack heading. After designating the target and selecting A/G master mode, azimuth steering is available via command heading and the ASL. In addition to range, the CC also computes the time to reach the pull-up point to provide maximum range (or selectable angle) and displays TPULL in the HUD data block.

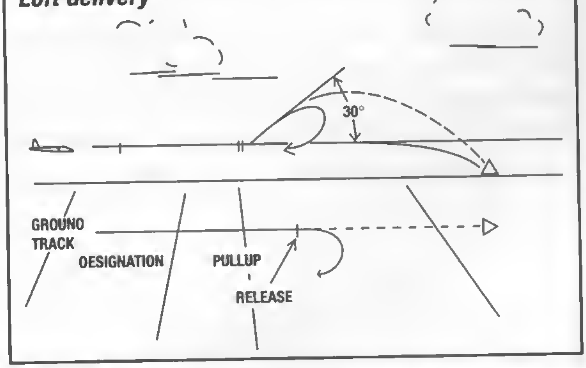
Five seconds after pull-up begins, the CC checks to verify G-loading is 4 ± 1 and climb angle has reached at least 15° to determine whether steering is being followed.

At ten seconds TREL, the release cue appears on the ASL above the velocity vector. When it reaches the velocity vector, if the pickle button is held down, the CC generates the release pulse and the bomb is released. After the bombs are released, roll to 120° of bank and pull the nose back down below the horizon with 4-5Gs. After approximately 120° of turn, the target will be near 6 o'clock as the roll-out generates maximum separation from weapon effects.

Loft Considerations. Because of the long TOF (time of flight/fall) for loft deliveries, minor azimuth deviations may result in large impact errors. Fly the delivery at the planned parameters (airspeed, altitude, etc.) and pay particular attention to steering cues. The loft should be practiced as a night TF (terrain-following) event.

The loft recovery is a self-inflicted unusual attitude recovery, at night, close to the ground. The pilot should, however, fly the egress so as not to mask the target prior to weapon impact, which may require a less aggressive recovery. If there is any doubt, go through dry.

Loft delivery



CDIP Mode

The CDIP mode is a very accurate mode for visual bombing in the F-15E under most conditions. The ability to manage the system improves bomb scores from merely qualifying to outstanding. The CC accomplishes many of the tasks (wind correction, gross weight/density altitude/AOA correction) required of the pilot flying manual deliveries. The current bomb range computed by the CC is used to display the HUD pipper at the point where the bomb will impact if pickled immediately. This technology advantage results in more accurate bombs, but can also make pilots lazy about establishing parameters. Although the computer gets the bombs on target, it does not necessarily provide a safety margin for frag clearance, desired impact angles, fuze arm times, or burst altitude of weapons. The crew must plan for all these factors using specific release conditions, and the pilot must strive to achieve the required parameters during the delivery.

Factors Affecting CDIP Accuracy

There are two groups of error in CDIP deliveries. These are trajectory and release point errors and system management/ranging errors. The first group is controlled by the pilot and can be minimized with good roll-in, track, and pickle (parameters) techniques. The second involves knowledge of the system and how it computes the bomb release solution, as well as controlling the system for the best results.

If the pipper is not on the target at pickle, chances are the bomb will not hit the target. Usually aiming error is due to poor roll-in and tracking technique, resulting is rushed and inaccurate pipper placement. Fly a smooth, consistent roll-in and place the velocity vector long of the target. Hold the velocity vector on the AOD with slight forward stick pressure while allowing the pipper to track smoothly up the DIL to the target.

Timing of the pickle is critical to CDIP accuracy. Anticipate the arrival of the pipper over the target. Press and hold the pickle button down as the pipper covers the target. Do not "quick pickle" as this may lead to a dry pass. If the pipper is slightly right or left of the target, accept the error and do not attempt a last-second correction, as you will invariably pickle long.

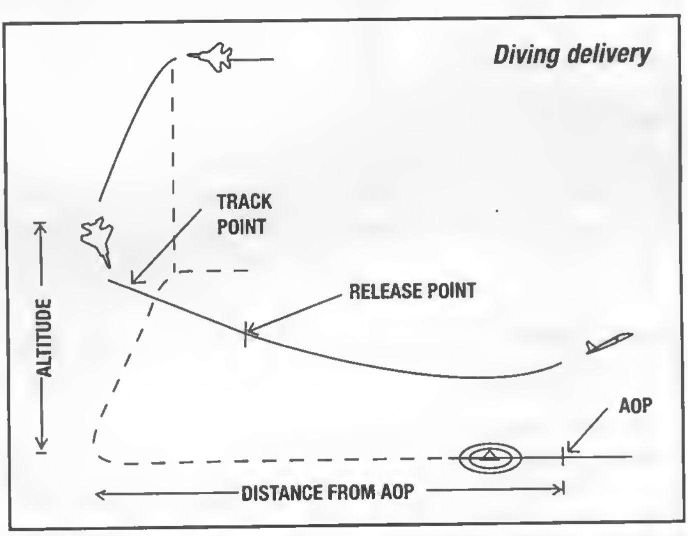
CDIP Delivery Types

Although there are several different types of CDIP deliveries, the similarity of diving deliveries allows discussion of them as being either level or diving.

Diving Delivery

The procedures and techniques for CDIP diving are similar for all release angles. Climb to altitude and stabilize at the briefed airspeed. Use 3-4Gs to roll out at the proper distance from the targets. Adjust airspeed and altitude to meet planned parameters, and angle in or out if the base distance is wide or tight. Set MIL power, and smoothly roll and pull the nose toward the target with 100° to 120° of bank and 3-4 Gs. As the nose drops, reduce bank angle to hold the planned dive angle. Disregard the CDIP pipper initially, as this symbology is "buried" in the bottom of the HUD. Fly the nose of the jet to a point long of the target.

During the 3-5 seconds of tracking time on final, trim or maintain slight forward pressure on the stick to maintain dive angle and to slow the pipper tracking rate. If the DIL is not centered on the target, make an immediate correction to get it there. Then, use small smooth corrections to center up the DIL. Hold a shallow bank angle to keep the DIL centered. Anticipate the arrival of the pipper on the target. Approaching the release point, especially when flying low altitude/low dive angle deliveries, the pipper tracking rate appears to increase. Do not compound this problem by "pulling" the pipper early. Continue making small bank corrections, but try to stabilize the aircraft for 1 second before pickle to allow the pipper to stabilize. Depress and hold the pickle button until release occurs.



Visual Level Bomb (VLB) Delivery

The CDIP delivery is normally a backup to an Auto level delivery, but is sometimes practiced intentionally. Fly no lower than the minimum release altitude based on crew qualification or frag considerations for the best accuracy. Use caution to avoid the common tendency to enter a slight dive approaching the target. Keep the DIL on the target. Fly as wings-level as possible during the tracking phase. Anticipate the arrival of the pipper over the target, and hold the button down.

Level Considerations. Transition to CDIP on a level pass is usually a back-up for an Auto delivery, so brief when and how you will transition to CDIP in the crew briefing. Consider setting a TREL minimum, such as 10 seconds, for the decision to default to CDIP or go dry. Identify bad steering early to avoid large heading changes.

CDIP Error Analysis

Between passes, analyze the previous pass to determine what corrections, if any, should be made on the next pass. Any deviation from the planned release parameters, errors in ballistics/mil setting calculation, or aiming error will result in a miss. With a correct sight setting and the pipper on the target, the following errors in a specific release parameter result in the listed impact error.

	Release Parameter	Impact Error
Dive Angle	Shallow	Short
	Steep	Long
Airspeed	Slow	Short
	Fast	Long
Altitude	High	Short
	Low	Long
Bank		Short, laterally in the direction of the bank
G-Loading	Pull	Short
	Bunt	Long
Skid		Laterally in the direction of the skid

Corrections. If you did not have the proper aim point, recompute and move it. If the problem was tracking the aim point, resolve to track more accurately.

If you had an error in parameters, the most likely problem is the base leg was not properly flown. Improper base leg position can result in dive angle and altitude errors. Roll-in technique is most often responsible for airspeed problems.

Mission Planning

Weaponeering

Whether you are planning a continuation training (CT) sortie or an actual combat mission, the objective is still to inflict a certain level of damage on the assigned target. This level is dictated by the ATO or frag, or is determined by the flight lead using the joint munitions effectiveness manuals (JMEM). The JMEMs describe the Pk (probability of kill) of various weapons against different type targets. Total or 100% destruction is usually desired, but this is difficult to achieve without unlimited resources or expensive guided weapons. Your job when planning the mission is to attain the highest level of damage with the weapons provided.

Considerations

Several factors to consider include:

1. *Target* — location, size, composition, coordinates, and photos.
2. *Threats* — location, type, numbers, status, and capability.
3. *Force composition* — flight size and support assets.
4. *Weapons* — guided/dumb and numbers.
5. *Delivery* — target designation, weapons accuracy/effectiveness, radar/visual.

While a level delivery from medium altitude may maximize target radar acquisition and weapons effects, accuracy required for unguided weapons may force a lower release altitude, and a standoff delivery such as a loft or LRDT may be required due to target area defenses. The final attack profile will always be a compromise between exposure to the threat, delivery accuracy, and weapons effects/target destruction. The flight lead must determine which decision factor takes the highest priority on each particular mission.

Attack Profile Selection

Some of the basic attack profiles are level, loft, dive toss, pops (offset pop and direct pop), and systems deliveries. Basic characteristics, advantages, and disadvantages are detailed for each of the six profiles.

Level

This attack is usually conducted from low altitude, but is a viable medium altitude delivery also. Advantages of the level attack profile include less maneuvering for ease of navigation and timing, capability to attack under a low ceiling, reduced exposure to threats, and lower overall crew workload. Disadvantages include weaponeering restrictions such as maximum altitude for fuze arming and weapons effects (impact angle), visual acquisition difficulty, straight-line two-dimensional flight to the target — simplifying threat acquisition and track of the friendly aircraft — and frag deconfliction between formation members. Execution of the level attack from medium altitude decreases crew workload, but exposes the aircraft to other threat envelopes and greatly decreases unguided weapons accuracy. Due to disadvantages of the level attack profile and the accuracy of the F-15E using other profiles, it is usually the last choice, forced by weather, degraded systems, or weapon tactics restrictions.

Loft

This profile combines the standoff from frag and threat advantages of a medium altitude level delivery with the low exposure profile of a low altitude level attack. Although visual acquisition is not a viable back-up for this delivery, with a good target designation, the loft delivery can be as accurate as a level delivery with F-15E avionics. Munitions such as proximity-fuzed CBUs can be delivered from low altitude using the loft maneuver, something not possible in a low altitude level attack. Due to the standoff aspect of this delivery, frag clearance is not a factor for attacking aircraft or wingmen, but maneuvering a two-ship during a loft attack and egress can be complex. Disadvantages include increased exposure to threat envelopes, but this is partially negated by the three-dimensional maneuvering of the profile and the standoff range from the target. Another disadvantage is the level of aircrew workload required to accomplish this profile, especially at night.

Dive Toss

This delivery is a low altitude attack profile which combines standoff capability with visual acquisition/designation benefits. Initially, the profile is flown like an offset pop, but with a pull-up 2-3nm further away from the target. This results in a shallow dive to enable finding and designating the target with the HUD pipper or TD diamond, followed by an Auto release and recovery outside threat ranges. Advantages in addition to standoff from threats and frag include liberal tracking parameters, positive visual ID of the target, and the ability to designate the target and then select a different attack axis. Disadvantages are similar to those for the loft delivery, including task saturation, exposure to threats, difficulty in visual acquisition from longer ranges, and less accuracy than a CDIP delivery.

Offset Pop

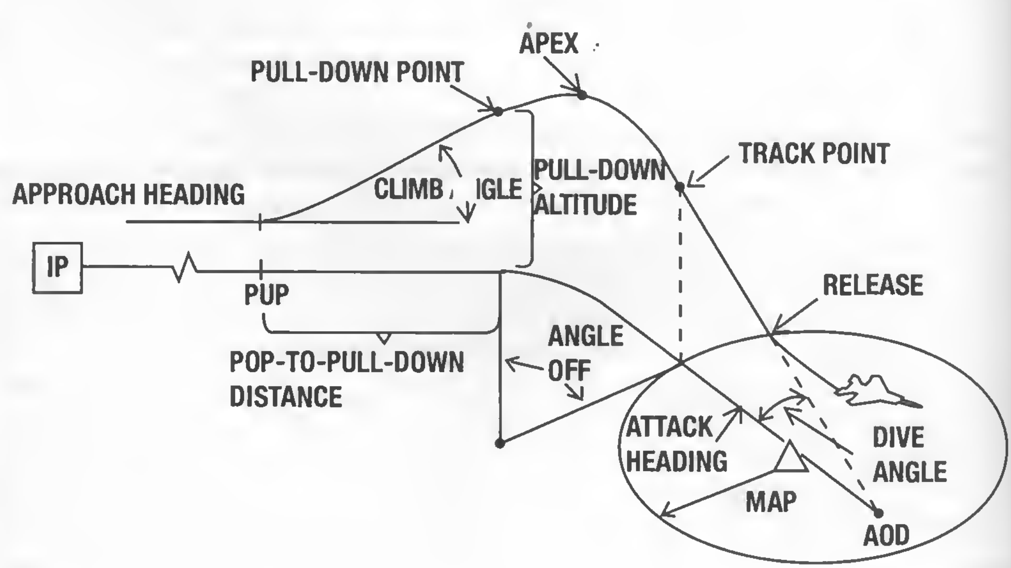
This low altitude profile is used to get the aircraft into a position to deliver low or high drag weapons using a CDIP release with minimal exposure. High-drag munitions can be delivered from a shallow (10°) dive with low release altitudes, while low drag munitions require a 20°-30° dive and corresponding higher release altitudes to satisfy all weapons effects, dive recovery, and frag clearance requirements. A low altitude ingress is flown toward the target area. The aircraft can be flown directly at the target and "actioned" left or right just prior to pull-up, or can be flown directly to the pull-up point. At the pull-up point the aircraft is flown at a steep climb angle with the target offset to the side for easier visual acquisition. From a predetermined pull-down altitude, the aircraft is flown to CDIP release parameters, then an escape maneuver is flown to avoid the frag and return to low altitude.

Because the pilot uses a CDIP designation and minimum release range, this profile is very accurate. The aggressive maneuvering in the pull-up, pull-down, and escape maneuvers make the aircraft difficult to track, and exposure is planned to be the minimum required. Formation mutual support is enhanced, as the flight members in the pop are easily visible to those still at low altitude. With a high enough release altitude, frag deconfliction is simplified, and several aircraft can attack the target in just a few seconds. This profile is not very flexible, however. It requires precise planning and execution, and is task-saturating, especially in multi-ship formations. A minor navigation error can place the aircraft either well inside or outside planned attack parameters. During the tracking period, the aircraft must be flown in a straight and level attitude (predictably) to ensure accurate CDIP pipper placement.

Direct Pop

This delivery adapts the pop-up attack to night LANTIRN operations. By using a straight-ahead pull-up and pull-down (zero angle-off), no offset to the pull-up point is required — just a range to the target. Using the N-F HUD display, the pilot can confirm the target area visually at night, redesignate (if required) and attack the target with Auto/CDIP. The direct pop is planned as a primary attack or as a back-up to a loft. In most cases, however, the disadvantages make this a delivery adapted to very few situations. For range to the target to accomplish the maneuver, the pilot still requires an accurate designation. Unless a "bad" loft is recognized before or right at pull-up initiation, a transition to a direct pop is difficult, if not impossible. The maneuver can be very disorienting, and there is a potential for the pilot to misinterpret the HUD/ADI displays. First-look target identification in the N-F is feasible only for large targets, such as buildings, industrial complexes, or airfields. There may be situations, however, where the direct pop gives the best combination of threat avoidance and target detection and destruction.

Pop-up terms



Systems Delivery

The above deliveries all use aircraft systems. An Auto delivery, using release techniques similar to a dive toss or direct pop, is the normal release option, but CDIP can be used with steep dive angles. Advantages of this maneuver include long track time, ability to redesignate using the HUD/N-F (if required), no terrain masking during mapping, avoidance of the frag, ground, and small arms/AAA/short range SAMS, additional time and airspace to detect/evade/defeat SAMS, and overall lower crew workload. Disadvantages of this profile are greater exposure to AI (Air Intercept) and SAM threats, visual target ID difficulty, and degraded weapons accuracy, especially in cross-winds.

HRM Planning

After the low level route has been planned, it is important to select radar offset aim points for system updates or target designation. To obtain usable HRM presentations without excessive maneuvering, several factors must be considered during the cruise, low level, and attack phases of the mission.

Medium Altitude Cruise

A significant cultural or geographic feature should be selected as an update point prior to the low level descent point to ensure all flight members have accurate navigation capability prior to descent. Large bridges, airfields, or distinctive isolated peaks are all good options. Select a point far enough left or right of the planned route to allow straight-line navigation without check turns to obtain an acceptable squint angle. Also, select points at sufficient range to maintain the radar graze angle under 20°. At 20,000ft, the minimum range for this angle is 10nm; therefore, plan to take the maps in the 15-25nm range.

Low Level Ingress

Select points to map which require the least maneuvering in heading and altitude, as this will assist in avoiding detection. The best way to accomplish this is to select points which move into a window of optimum mapping during straight-line navigation. For squint angle considerations (which affect map quality and designation accuracy), take the map at least 30° off the nose. Ensure time to get two maps prior to radar gimbal limits by planning to cease mapping by 50°. The combination of range to the point and aircraft altitude will affect map quality due to graze angle.

By planning the distance traveled between the squint angles of 30° and 50°, you can determine the amount of time available for mapping. Closer offsets result in shorter available map time but higher graze angles. More distant points sacrifice graze angle, but allow more available time for mapping. Try to select points which offer the best combination of both factors.

Other factors to consider include intervening terrain which might mask the point, or trees in the offset area. Either factor will require a climb to obtain an acceptable map. Finally, coordinate mapping between flight members. The flight lead will not want all members heads-down getting updates simultaneously with no one monitoring the A/A radar or checking 6 o'clock.

Ground Clearance

The altitude lost during dive recovery is the vertical distance above the ground where the pilot must initiate the pull-out maneuver to ensure zero ground clearance, as shown in the table below. A 5G, wings-level recovery attained in 2 seconds is assumed. The desired ground clearance is added to the listed altitude lost during dive recovery to get a minimum release altitude.

Dive Angle	Altitude Lost
10°	260 ft
15°	460 ft
20°	690 ft
30°	1380 ft
45°	2200 ft

***Note:** Sea level target, 500 KTAS. 5 Gs in 2 seconds pull-up assumed.*

Safe Escape and F-15E Avionics

The F-15E HUD displays a "Frag Cue." In situations where a frag cue is displayed, the cue represents the predicted frag envelope for whatever weapon is on board and in priority. As long as escape maneuvering results in the velocity vector being above the frag cue at detonation, there should be no frag damage.

The CC does not compute a minimum altitude for safe escape. This is the crew's responsibility and is accomplished only by reference to the safe escape table(above) and the **Dive Recovery** chart (p. 204).

LOW-ALTITUDE OPERATIONS

Introduction

The F-15E is optimized to ingress and egress at low altitude both day and night. Although the INS, TSD, TFR, and LANTIRN give very reliable low level capability, crew proficiency is still the most critical aspect of low altitude operations. This chapter discusses the following low altitude topics: awareness and considerations, and low-level navigation techniques.

Awareness And Considerations

Altitude

Fly only as low as necessary to avoid the threat and optimize weapons employment. At some altitude, all pilots cease performing all tasks except terrain avoidance. For this reason, more and more duties are delegated to the WSO as altitude decreases, but the aircraft should not be flown lower than crew comfort allows. If the WSO spends all his time checking 12 o'clock, you are too low. Fly at an altitude that is comfortable to both crew members. Raise the minimum altitude as task loading increases or when the tactical situation allows. In an emergency or abnormal situation, climb immediately to a comfortable altitude.

Airspeed

Higher airspeeds decrease the time exposed to a specific threat, but increase the difficulty of maintaining desired altitude. While terrain masking in rough terrain, a slower airspeed (400-450 KCAS) may be required to keep the turn radii small enough to stay in the canyon or hug terrain.

Threats and Terrain

Over relatively flat terrain, all threats have better low altitude capabilities. As terrain gets rougher, the threat minimum altitude gets higher. Do not try to fly at 100 feet AGL if the terrain does not permit it or the threat does not require it.

Altitude Reference

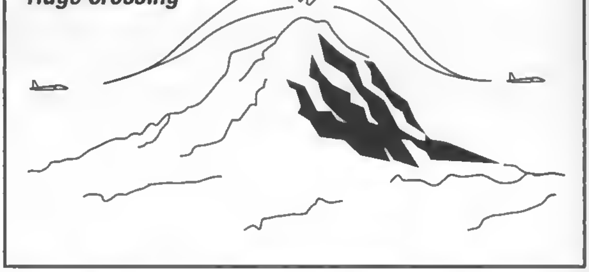
The horizon and ground objects near the aircraft serve as the altitude reference. The radar altimeter can assist in calibrating altitude awareness. It is relatively easy to maintain desired altitude over terrain consisting of large ground objects such as trees or rocks. However, as the size of the ground objects decrease, determining how high you are visually becomes more difficult. Most pilots have a strong tendency to descend to lower than desired altitudes over flat, even terrain. Very flat terrain or calm water is surprisingly dangerous because of a lack of depth perception. Over flat terrain, it is easy to sink to a dangerously low altitude without realizing it. Flat, sloping terrain is more hazardous because of the insidious change in elevation as you fly into a gentle up-slope. Use the radar altimeter to improve altitude awareness as the terrain features change. In some extreme conditions of flat, featureless terrain or water and poor visibility, the CARA (combined altitude radar altimeter) becomes the primary source of altitude reference. Under those conditions, consider engaging the TFR (terrain-finishing radar).

Ridge Line Crossings

Crossing ridge lines in high threat areas is a dangerous move. The aircraft is highlighted to threats, both ground and air. Avoid ridge crossings if at all possible. Obviously, many situations force you to cross ridges. Accordingly, plan for and practice good ridge crossing techniques. Three ridge crossing types are commonly employed.

Perpendicular

This crossing minimizes enemy radar or visual acquisition but should be done only when you know your 6 o'clock is clear. Accelerate as required to maintain tactical airspeed during the pull-up. Pull early enough to avoid a large overshoot crossing the ridge, so you crest the ridge at your specified minimum low level altitude. To go down the back side, bunt or roll and pull. A totally inverted pull-down is prohibited. At the crest, unload and roll to approximately 120° of bank, then slice down. At the desired nose low position,



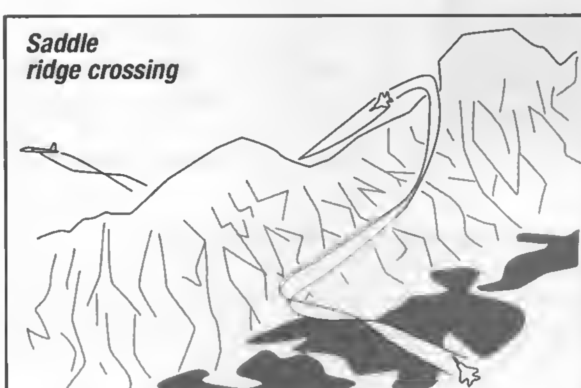
Perpendicular ridge crossing

roll-out and resume low level flight. Initial attempts at this technique should be limited to a 15° nose low attitude. DO NOT bury the nose in the new valley. This maneuver may put you belly up to unexpected high terrain on the other side of the mountain. Consider wing flash during the slice/pulldown; it is highly visible. The roll and pull technique is most effective when crossing large, steep, isolated ridge lines. A bunt or pushover is more appropriate for milder, rolling terrain. The advantages of the bunt are straight line navigation, no wing flash, and less crew disorientation. Remember the zero-G transient and 10-second negative-G restrictions.

Parallel

This type of approach is appropriate if your 6 o'clock is (or may be) threatened. It denies the bandit a blue-sky background and provides a difficult guns environment. Instead of a straight approach to the ridge, turn to arrive at the pull-up point with approximately 45° of crossing angle to the ridge. Pull up later than for a perpendicular crossing, and continue to turn in the climb to be parallel to the ridge crest just below the top. Roll and pull into the ridge, to cross the crest at your specific minimum altitude. Continue a loaded roll to fly down the backside of the ridge, on a heading 90-135° from the ridge line. Roll-out and continue the low level.

Saddle



The saddle type ridge crossing is similar to the parallel, and can be used when you are threatened. Turn to parallel the ridge line below the crest until you can use a saddle, canyon, or the end of the ridge to cross to the other side. The exact maneuver is dictated by terrain characteristics, but can be as simple as a level 90° turn.

Sun Angle

Avoid flying into a low sun if possible. Low sun angles reduce depth perception, cause long shadows, and obscure terrain features. You can normally see the horizon but cannot see anything between you and the horizon due to shadow. This makes low altitude flight very difficult and visual target acquisition nearly impossible. The HUD may be unusable when flying into the sun. If a navigation leg must be flown into the sun, consider using the TFR and NAVFLIR.

Insidious Descent

One of the most dangerous aspects of low altitude flight is insidious, unplanned descent into level terrain. The following data should help you understand the cross-check required for very low altitude operations.

Wings-Level Shallow Dive

In wings-level flight at 300 ft, if the aircraft is in a 2° dive at 480 KTAS, time to ground impact is 10.5 seconds. If the dive is not detected and recovery not initiated within approximately eight seconds, ground impact is unavoidable. At lower altitudes, these times decrease (e.g., at 100 ft, wings-level, 2° dive, 480 KTAS, ground impact occurs in 3.5 seconds). Pull-out must be initiated within the first second to avoid hitting the ground. See the table below for additional examples.

		Dive Angle				
		1°	2°	3°	5°	10°
Altitude	100 ft	7	3.5	2.3	1.4	0.7
	200 ft	14	7	4.6	2.8	1.4
	300 ft	21	10.5	6.9	3.2	2.1
	400 ft	28	14	10.2	4.6	2.8
	500 ft	35	17.5	12.5	6.0	3.5

Time to Ground Impact (seconds)

Note: *Impact times calculated at 500 KTAS.*

Low-Level Navigation

Low-Level Planning

Factors affecting route selection include the mission objective, threats, terrain, weather, and visual/radar significance. The mission objective (target, desired level of damage, etc.) has a significant impact on the attack plan.

Weaponeering

A requirement for specific attack aids can affect the desired routing to the target, so it is usually best to pick the IP (initial point) and plan the attack first. Then plan the route to get to the IP and egress from the target.

Threats

Enemy threats are perhaps the greatest factor in low level route selection. Avoid the threat when possible, and when necessary to fly through threat envelopes, plan the route to degrade the threat's capabilities. Current intelligence on the location and movements of enemy units is essential.

Terrain

Where possible, use terrain features to mask the flight from threats and provide tactical surprise in the target area. Avoid crossing ridge lines. When ridge lines cannot be avoided, plan and execute crossing them.

Sensor Aim Point and Offset Selection

Plan for several update points along the low level. If two-ship or four-ship operations are planned, choose enough update points to allow for alternate updates if threats, route adjustment, or other mission tasks prevent use of the primary point. If flying in hilly terrain, the window of opportunity for mapping an update point may be limited.

Visual Update Points

Consider planning at least one visual update point. Choose a point reasonably close to the target area, to provide back-up weapon delivery capability in the event the radar HRM mode is inoperative, terrain or threat reactions prevent getting a HRM map, etc.

NIGHT OPERATIONS

Introduction

Night operations provide several advantages over less sophisticated enemies including surprise, denial of visual acquisition, 24-hour operational capability, and psychological impact. Although LANTIRN, the TSD, and other systems in the F-15E make it an easy system to employ in the dark, night operations are always more demanding and hazardous than day VMC (visual Meteorological conditions) operations. Therefore, make some special considerations when conducting night-time operations.

Night Flight Preparation

First, check your personal equipment. Each crewmember should carry a flashlight. Wear a clear helmet visor. Mission materials and lineup cards need to be clearly marked and easily readable in a darkened cockpit. Consider taking tape to cover undesired light sources. Familiarization with the location of critical cockpit switches is important.

Route Planning

Establish MSAs (minimum safe altitudes) for the route. In most cases, good visual turnpoints make good FLIR turnpoints. The two ingredients of valid FLIR turnpoints are IR contrast and vertical development. It is best to have both, but as a rule, IR contrast is the most important. A point with vertical development not only enhances FLIR acquisition, it is also more likely to be a radar show point. A point which has good IR contrast, vertical development, and is radar significant makes the ideal LANTIRN turnpoint, IP, or target. Maximize terrain masking, but plan the route to avoid or minimize the effect of large terrain features on TF operations.

Intel Support

LANTIRN requirements for intel can be broken into two broad areas:

Target Area Considerations. The quality of TDA(tactical decision aid) provided depends on the accurate, detailed definition of target and background characteristics. The use of photography for TDA information and aircrew study substantially increases the probability of first pass success.

Target/Turnpoint Accuracy Requirements. At night, there is little capability to take a quick glance to the left or right and see the turnpoint or target. The navigation system must be accurate enough to center the FLIR/TGT IR FOV on the target at the expected acquisition range. This roughly equates to a minimum system accuracy of .2 to .3nm. Plot turnpoints to an accuracy of 100 feet in both the horizontal and vertical.

A/A Radar

A/A radar should be used to maintain formation spacing at night. A good search plan includes altitude coverage for the wingmen which allows them to cross-check other flight members occasionally. Avoid locking on to the preceding aircraft unless absolutely necessary.

Display Management

Plan this function before stepping to the aircraft. Because the ADI, TF, and other "night" displays use scopes you employed for other displays in the daytime, plan scrolling carefully. Consider programming only two displays per scope. This allows you to "toggle" between displays, a technique some crews find easier to manage. Have a plan if you end up flying with one display inoperative.

Minimum Essential Systems List (MESL)

Review this list for night/TFR (terrain-following radar) operations, and plan an alternate mission if unable to fly the primary mission due to system problems.

MECHANICS

OVERVIEW

This chapter contains charts, tables, lists and other information about the F-15E and the other aircraft you'll encounter while playing the game. Some are taken from the USAF F-15E instruction manuals. The rest are straight from the game.

F-15E Performance includes charts and tables describing the F-15E's flight characteristics. When there isn't a line on a chart that matches your current configuration, make an estimate based on the two lines that bracket that configuration.

- **Mach/Altitude/Speed** (p. 199) charts relationships between current altitude, indicated airspeeds and Mach ratio.
- **Time to Climb** (p. 200) charts how long it will take to climb to a new altitude.
- **Stall Speeds** (p. 202) charts at what speeds your F-15 begins to stall.
- **Dive Recovery/Emergency Pull-Out** (p. 204) charts how far you will continue falling, after you begin to pull out of a dive (whether planned or unplanned). It also includes a few basics of dive recovery.
- **Cruise Efficiency** (p. 206) lists how many nautical miles you'll get per pound of fuel, based on altitude and drag index. It shows the most efficient altitudes for long-range cruising, along with the most efficient Mach.
- **Combat Ceiling** (p. 207) charts how high you can fly.

Player Aircraft Stats includes the numbers and other information you need to customize your aircraft for any specific mission.

- **Weapon Advisor** (p. 209) summarizes the game's Weapon Advisor information.
- **Drag Index and Weight** (p. 210) describes *drag index*, then lists the drag index and weight of every store possible for your F-15E.
- **Allowable Stations/Weapons** (p. 212) lists which stations can mount which weapons and other stores.
- **Ordnance** (p. 214) briefly describes each of the weapons you have available.
- **Fuel Quantities** (p. 215) calculates how much fuel you can carry.
- **Default Loadouts** (p. 216) details the eight default loadouts available to you, then briefly analyzes the best uses for each loadout.

Game Stats list all the crucial stats for everything else you'll encounter in *F-15*.

- **Aircraft** (p. 222) lists everything about the other aircraft, except their loadouts.
- **Weapons** (p. 224) details the weapons you fly with, and fly against, in the game.
- **Radars** (p. 228) has all the crucial range and radar type information.
- **Aircraft Loadouts** (p. 230) lists every possible loadout you might encounter.
- **Other Targets** (p. 238) describes what you'll find on the ground.

Damage System briefly describes the game's complex damage system, giving you the broad strokes of how damage is calculated, particularly for your own fighter.

F-15E PERFORMANCE

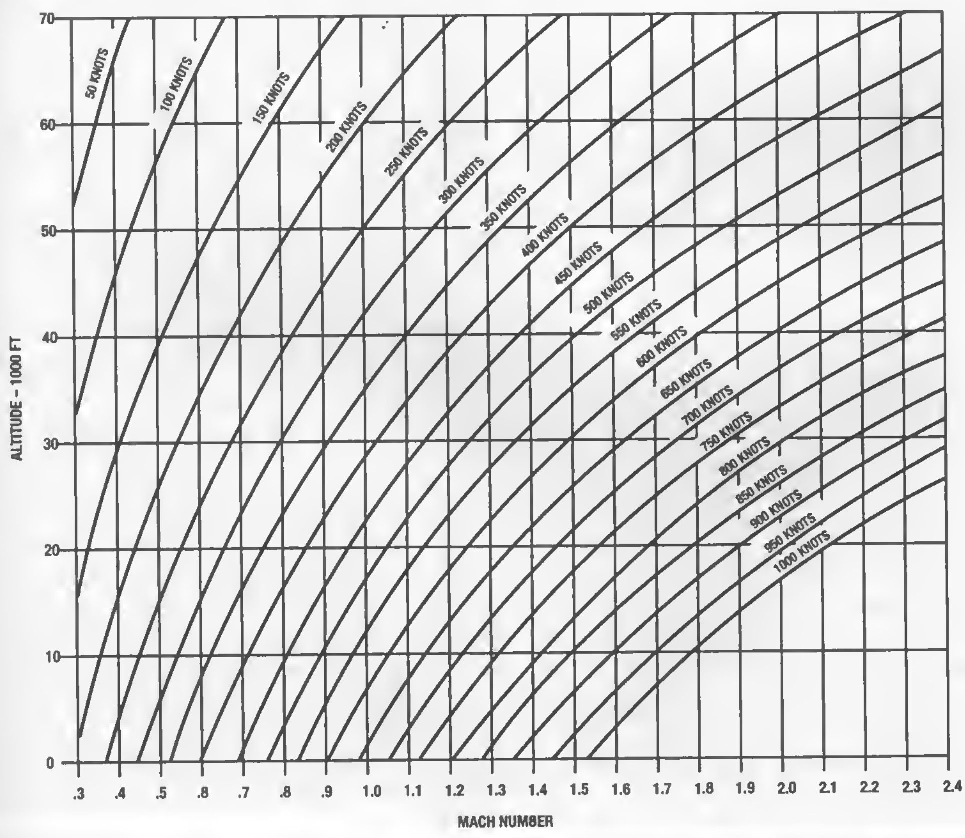
Mach/Altitude/Speed

The higher you fly, the thinner the air and the lower your indicated airspeed. However, even though your indicated airspeed is slower, you might actually be flying even faster than you were at a lower altitude. This chart tells you your current Mach, based on your current indicated airspeed and altitude. To use it:

1. Start with your current altitude, on the left side of the chart.
2. Read across till you meet the line for your current indicated airspeed.
3. Read down from that point until you reach the bottom of the chart. The result is your current Mach.

For example, assume your current altitude is 50,000ft, and your current indicated airspeed is 450 knots:

1. Start at 50 on the left edge of the chart.
2. Read across to the 450 knot line.
3. Read down from that point until you reach the bottom edge of the chart. You're flying just under Mach 1.7.



Time to Climb

The following two charts describe how long it takes an F-15E to climb to a range of altitudes, beginning the climb at sea level.

1. Start with your aircraft's gross weight, on the upper left side of either chart.
2. Read across until you meet the line for your desired altitude.
3. Read down from that point to the line marking your current drag index.
4. Read across from that point until you reach the lower left side of the chart. The resulting number is the time it takes to reach your desired altitude.

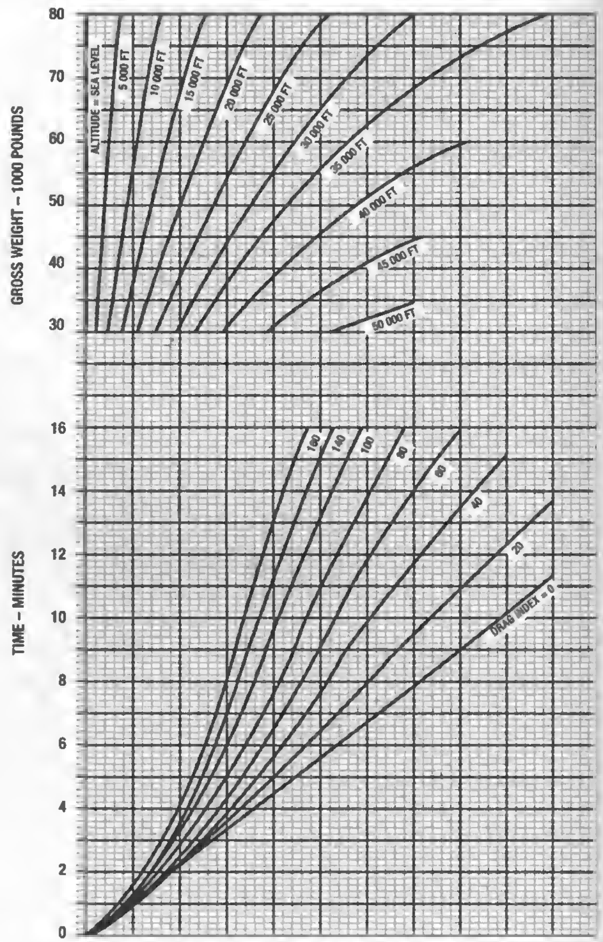
Three Notes:

1. Climb at 350 KCAS until you reach the appropriate Mach, then maintain that Mach until you reach your desired altitude.

   At Military Thrust:
   - For drag indices up to 40, climb at 350 KCAS until you reach .88 Mach.
   - For drag indices 40-100, climb at 350 KCAS until you reach .83 Mach.
   - For drag indices 100+, climb at 350 KCAS until you reach .74 Mach.

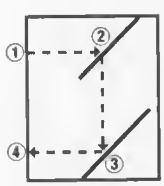
   At Maximum Thrust:
   - For drag indices up to 60, climb at 350 KCAS until you reach .95 Mach.
   - For drag indices 60+, climb at 350 KCAS until you reach .92 Mach.
2. Time from brake release to initial climb speed is about 1 minute for a military thrust takeoff and about half that time for a max thrust takeoff.
3. To calculate how long it takes to climb from a lower altitude to a higher altitude, calculate the time to climb from sea level for both altitudes. The difference between the two times is the time to climb from the lower altitude to the higher altitude.

Military Thrust

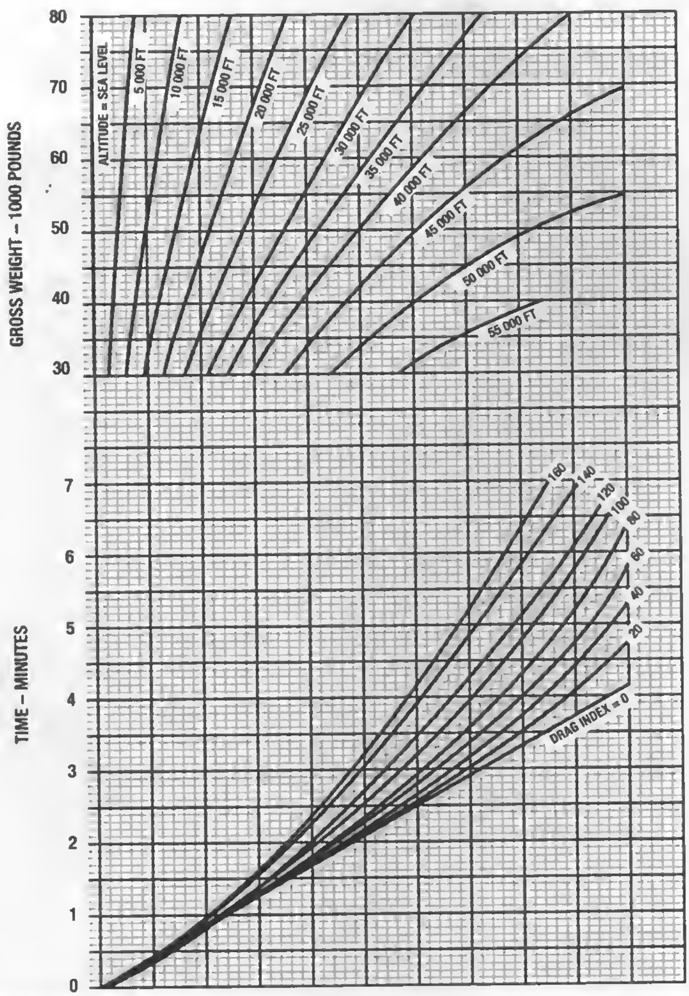


For a sample calculation, assume gross weight is 70,000lbs, drag index is 100, desired altitude is 40,000ft, and you're flying at military power (full normal thrust, but no afterburners):

1. Start at 70 on the upper left side of the first chart (Military Thrust).
2. Read across to the 40,000ft line.
3. Read down from that point to the 100 drag index line.
4. Read back across to the left side of the chart, where you find that your F-15E will take about 4:20 (minutes:seconds) to climb to 40,000ft. Add a minute for takeoff time (see Note #2, previous page), and total time to reach 40,000ft from the beginning of takeoff is 5:20.



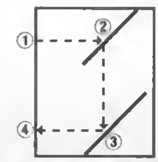
Maximum Thrust



Stall Speed

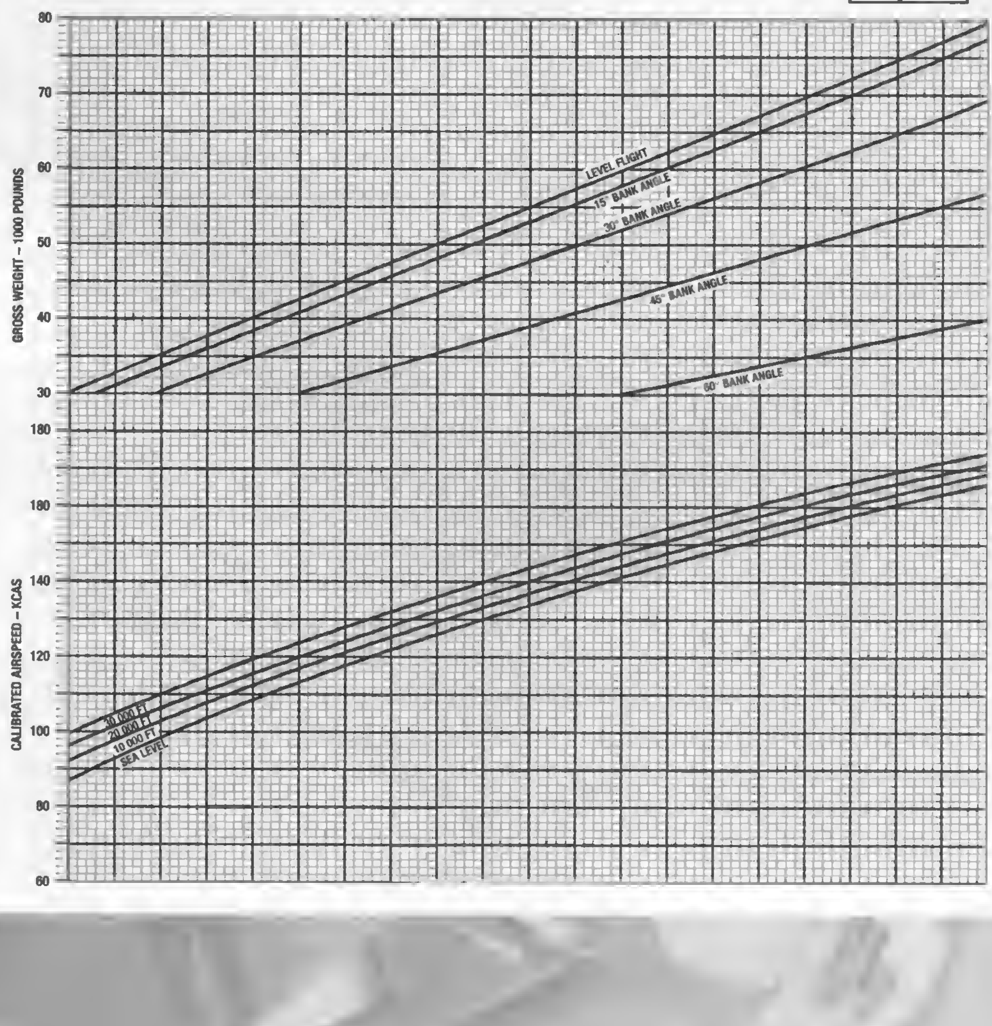
The Stall Speed charts (on these two pages) present stall speeds for various combinations of gross weight, bank angle, power setting and altitude. To use a chart:

1. Start with your aircraft's gross (total) weight, on the upper left side of the chart.
2. Read across till you meet the line for the aircraft's bank angle.
3. Read down from that point on the chart until you reach the line indicating your aircraft's current altitude.
4. Read across from that point till you reach the lower left side of the chart. The resulting number is the calibrated air speed (in knots) at which you will begin to stall.



Military Thrust

Flaps and Gear Down, All Drag Indices

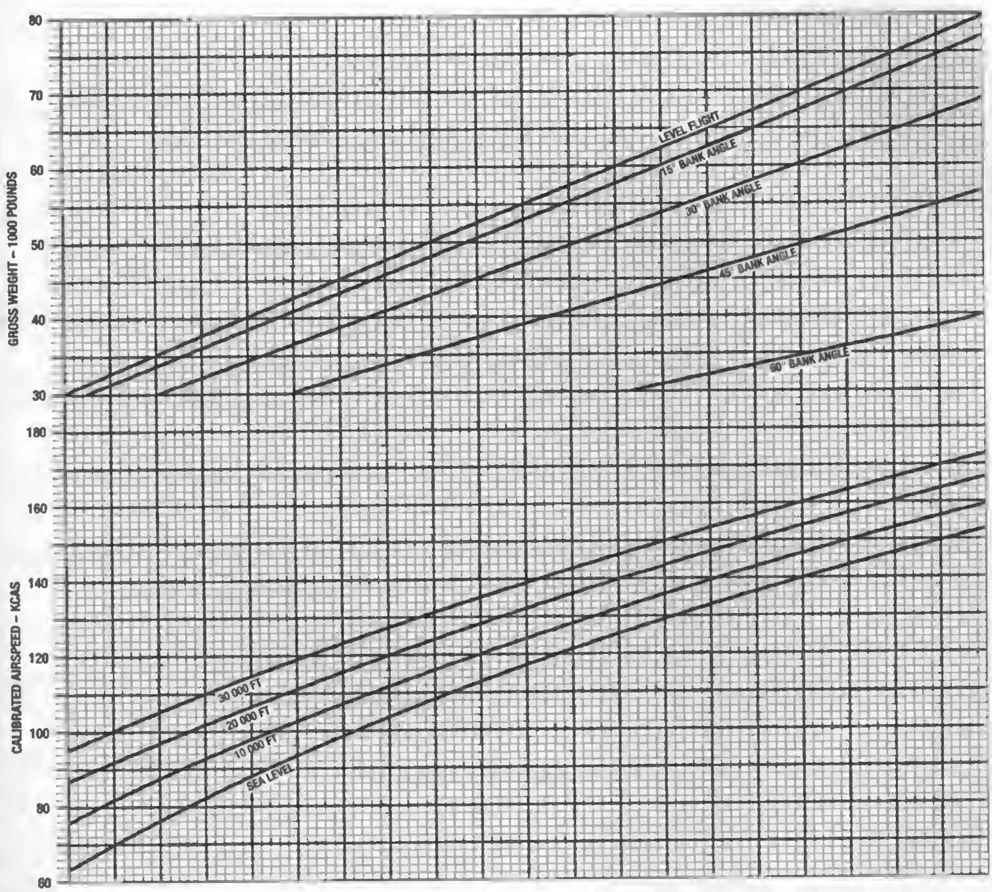


For a sample calculation using the first (military thrust) chart, assume gross weight is 50,000lbs, with level flight at 30,000ft:

1. Start at 50 on the upper left side of the chart.
2. Read across to the LEVEL FLIGHT line.
3. Read down from that point to the 30,000FT line.
4. Read back across to the left side of the chart, where you find that your F-15 will begin to stall at about 132 knots.

Maximum Thrust

Flaps and Gear Up, All Drag Indices



Dive Recovery/Emergency Pull-Out

This chart describes how much altitude you will lose in a dive — or rather, how much more altitude you will lose once you start attempting to pull out of the dive.

To use the chart:

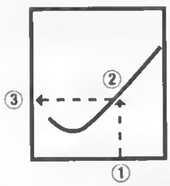
1. This chart assumes you are already in a dive. Start with your airspeed (in KCAS) while diving, on the bottom of the chart.
2. Read up until you reach the line for your aircraft's current dive angle (your angle before beginning to pull out of the dive).
3. Read across from that point till you reach the left side of the chart. The resulting number is the additional altitude you will lose once you begin pulling out of the dive.

For a sample calculation, assume you are in a 60° dive at 600 KCAS:

1. Start at 600 on the bottom of the chart.
2. Read up to the 60° line.
3. Read across to the left side of the chart, where you find that your F-15E will fall another 3800ft while you are recovering from the dive. Try to begin this dive recovery at least 3801ft AGL.

Additional notes:

1. At airspeeds below 350 KCAS, retract speedbrake and punch in full afterburners immediately, at the same time applying full aft stick or 12 Gs to wing rock.
2. At airspeeds between 350 and 500 KCAS, extend speedbrake and select idle power immediately, at the same time applying full aft stick or 10Gs to wing rock.
3. At airspeeds above 500 KCAS, extend speedbrake and select idle power immediately, at the same time applying 8 Gs.
4. Stick-in-the-lap pulls exceeding the recommended emergency pull-out G may result in severe structural failure.
5. Recoveries above 10,000ft are more restrictive. Recovery initiated above 10,000ft at the emergency pull-out Gs listed in the previous notes may also result in severe structural failure.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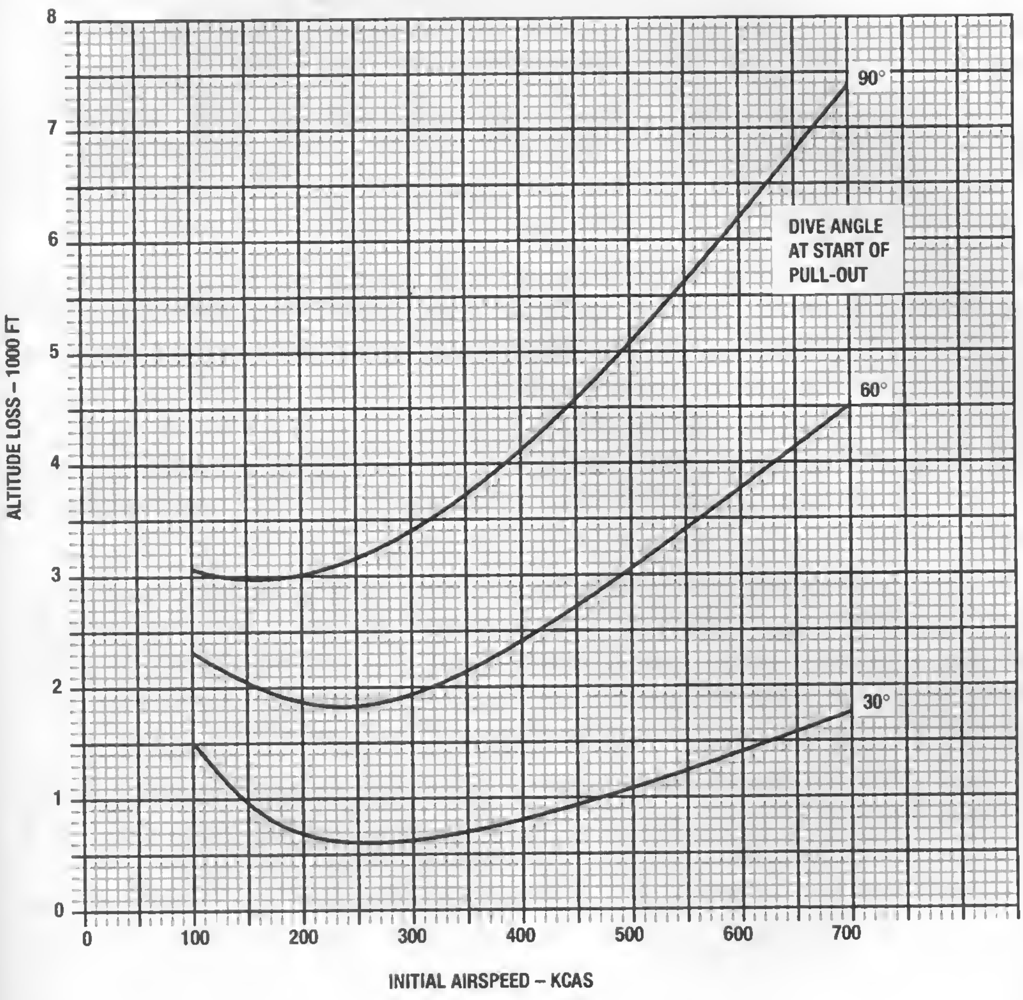

ALTITUDE LOSS – 1000 FT
0
1
2
3
4
5
6
7
8
90°
60°
30°
DIVE ANGLE
AT START OF
PULL-OUT
0
100
200
300
400
500
600
700
INITIAL AIRSPEED – KCAS

Cruise Efficiency

The altitude you maintain and your current drag index definitely affect your fuel efficiency. In general, the higher you fly and the fewer external stores you have, the more efficiently your F-15E will burn fuel, and the greater your total range. (See **Drag Index and Weight**, p. 210.)

Of course, factors other than fuel efficiency also influence your cruise altitude and total drag. You might be better off flying NOE to avoid detection, even though you are getting less than half the fuel efficiency possible at higher altitudes. And if you aren't carrying munitions, why bother making the flight?

The left half of the table (**Nautical Miles per Pound of Fuel**) gives your fuel efficiency at various altitudes and drag indices. For example, if your drag index is 80, you'd get .075 nm/pound of fuel at 35,000ft, but only .039 nm/pound of fuel at sea level — you can fly almost twice as far by cruising at 35,000ft.

The right half of the table (**Mach Number**) lists the appropriate speed (in Mach) for each altitude and drag index. Continuing the previous example, with a drag index of 80, you should fly at Mach .79 at 35,000ft, and Mach .44 at sea level for optimal fuel efficiency.

Knowing your current fuel stores and drag index, you can make a rough calculation of your current range (multiply current pounds by fuel x nm/pound). If that isn't far enough, consider climbing to a higher altitude or jettisoning some stores.

Of course, the typical mission involves more than cruising. Any other maneuvering (takeoff, air combat, avoidance, bombing, afterburner bursts and so forth) burn fuel at a much faster rate. This increased fuel expenditure must also be taken into account when calculating how much fuel you need to complete a mission, and whether you should change altitude or jettison external stores.

The game is always aware of your current drag index, so even though you begin a mission with a drag index near 100, you often are returning to base with a drag index nearer 20. This, too, must be taken into account.

	Nautical Miles per Pound of Fuel						Mach Number					
	Drag Index						Drag Index					
Altitude	0	20	40	80	120	160	0	20	40	80	120	160
45K	.111	.100	.091	.075	.060	.050	.91	.90	.90	.90	.90	.90
40K	.111	.101	.092	.077	.065	.057	.90	.89	.87	.85	.83	.81
35K	.104	.095	.086	.075	.065	.058	.88	.85	.83	.79	.76	.73
30K	.093	.086	.078	.069	.062	.056	.82	.79	.76	.72	.69	.66
25K	.084	.078	.072	.064	.058	.053	.76	.73	.70	.67	.64	.62
20K	.076	.070	.066	.059	.053	.048	.69	.67	.64	.61	.59	.57
15K	.068	.063	.060	.053	.048	.044	.64	.62	.59	.57	.54	.52
10K	.061	.056	.053	.048	.044	.040	.59	.57	.55	.52	.50	.48
5K	.053	.050	.047	.042	.039	.036	.54	.52	.50	.48	.46	.45
Sea Level	.048	.045	.043	.039	.036	.031	.49	.47	.46	.44	.43	.41

Combat Ceiling

Combat ceiling is the altitude at which the aircraft can no longer climb at 500 feet per minute. These charts present the military and maximum thrust subsonic combat ceiling for the F-15E. The variables of gross weight and pressure altitude are taken into consideration for a range of drag indices. (See **Drag Index and Weight**, p. 210, for a description of *drag index*.)

Your combat ceiling varies, depending on whether you're using afterburners. The top chart calculates your ceiling at military thrust (full normal thrust, but no afterburners). The bottom chart calculates your ceiling at maximum thrust (full afterburners). Both charts are on the next page.

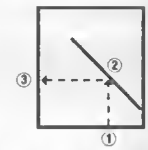
To read either chart:

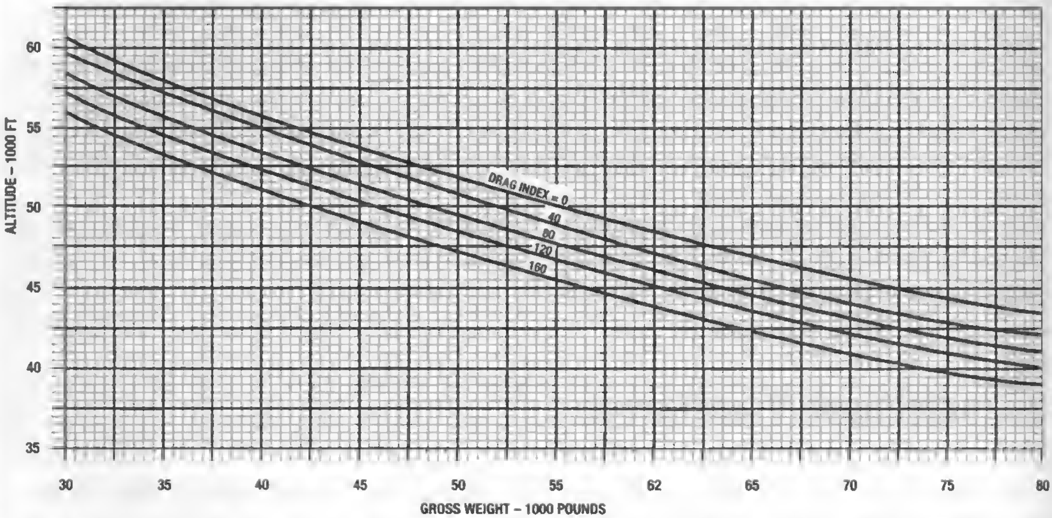
1. Start with your current gross weight, on the bottom edge.
2. Read up till you meet the line for your current drag index.
3. Read across from that point to the left edge, where you find your current combat ceiling.

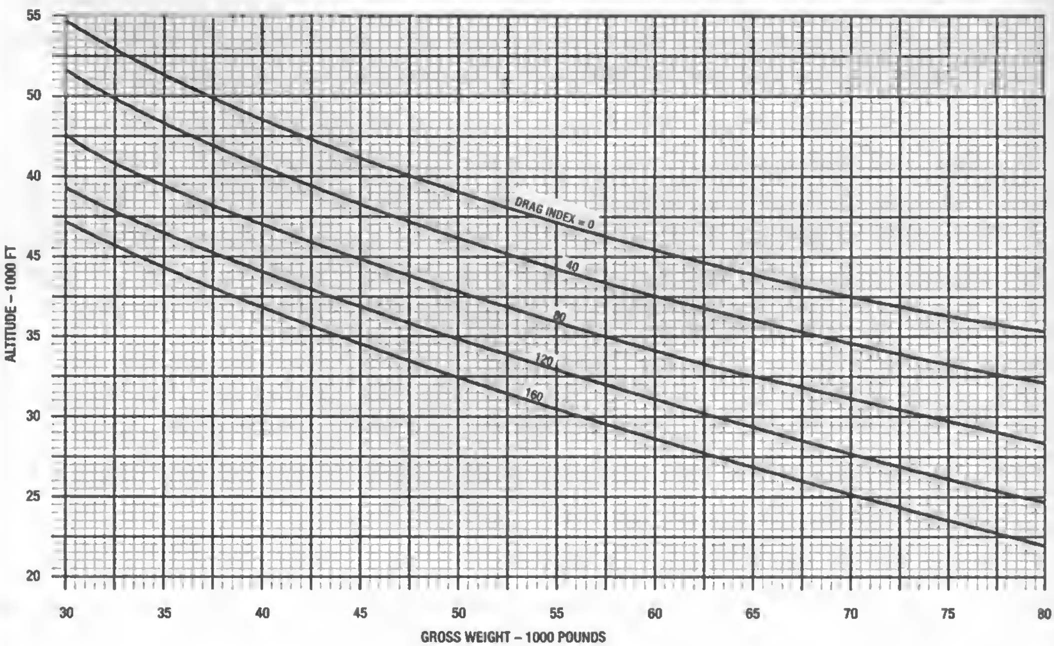
For a sample calculation, assume gross weight is 60,000lbs and drag index is 80:

1. Start at 50 on the bottom edge of either chart.
2. Read up from that point to the drag index 80 line.
3. Read across from that point to the left side of the chart. At military power, your combat ceiling is just over 34,000ft. At maximum thrust, your combat ceiling is just over 46,000ft.

Combat Ceiling, cont.







PLAYER AIRCRAFT STATS

Weapon Advisor

F-15's Weapon Advisor tells you which weapons work best against which targets. This table gives the same information, all on one page. (It's easier to display it all on paper than it is on screen!) Remember that this lists *optimal* weapon/target combinations — a weapon can often damage a target, even if they aren't listed together on this table.

	AIM-120A AIM-7F AIM-7M AIM-9L AIM-9M	M56A3 PGU-28/B	CBU-52 CBU-58 CBU-58A CBU-71 CBU-71A	CBU-87	Mk 82 AIR (BSU-49) Mk 82	GBU-12 GBU-12D	AGM-65D	Mk 20
Airborne aircraft	✱	✱						
Infantry		✱	✱	✱	✱			
Trucks		✱	✱	✱	✱			
Parked aircraft		✱	✱	✱	✱	✱		
Scud missiles		✱	✱	✱	✱	✱		
SAM vehicles		✱	✱	✱	✱	✱	✱	✱
AAA guns		✱	✱	✱	✱	✱	✱	✱
Armored vehicles				✱	✱	✱	✱	✱
Small ships					✱	✱	✱	
Small buildings					✱	✱		

	AGM-65G	CBU-97	BLU-107	Mk 84 AIR (BSU-50)	GBU-10 GBU-10E GBU-24 Mk 84	GBU-15(V)-1 GBU-15(V)-2	GBU-10G GBU-24A GBU-15(V)-31 GBU-15(V)-32	GBU-28
Armored vehicles		✱						
Small ships	✱							
Small buildings	✱							
Runways			✱	✱	✱			
Large buildings				✱	✱	✱		
Large ships				✱	✱	✱		
Bridges					✱	✱		
Bunkers/hardened aircraft							✱	
Large underground bunkers								✱

Drag Index and Weight

Several of the charts use the Drag Index system to effectively present the many combinations of weight/drag effects on performance. The following table contains the drag number and weight of each externally carried store. The drag index for a specific configuration may be found by multiplying the number of stores carried by its drag number. The total drag number (the drag index for that configuration) may then be used in other charts and tables.

An F-15E flying absolutely clean (no external stores at all, including no Conformal Fuel Tanks — CFTs), has a drag index of 0. This doesn't mean that the aircraft has no drag — it just means that an absolutely clean aircraft provides the baseline for drag calculations. All F-15E loadouts in the game include the two CFTs, with a drag index of 20.1, so the minimum possible drag index in the game is 20.1. The maximum possible drag index in the game is over 130.

Drag Index Example

Let's examine one of the default loadouts to calculate its drag index. The CAS loadout includes the following stores:

Store	Individual Drag Number	No. Loaded	Total Drag Index
Two CFTs	20.1	x 1 =	20.1
Centerline Fuel Tank	9.1	x 1 =	9.1
AN/AAQ-13	9.5	x 1 =	9.5
M56A3 20mm ammunition (500 rounds)	(internal — no drag)		0
Four AIM-9Ls	2.1	x 4 =	8.4
Six AGM-65Ds	3.7	x 6 =	22.2
Twelve Mk 20 Rockeye IIs	1.5	x 12 =	18.0
Total Drag Index for CAS default loadout			87.3

Weight

Weight is also a consideration. When you create a custom loadout, the game tracks your F-15E's takeoff weight. Below 65,000lbs, the Weight Bar is green, meaning your aircraft's weight is acceptable. Between 65,000lbs and 81,000lbs, the Weight Bar is yellow, warning you that you're close to maximum combat weight. Beyond 81,000lbs, the bar is red, indicating that the aircraft is overloaded.

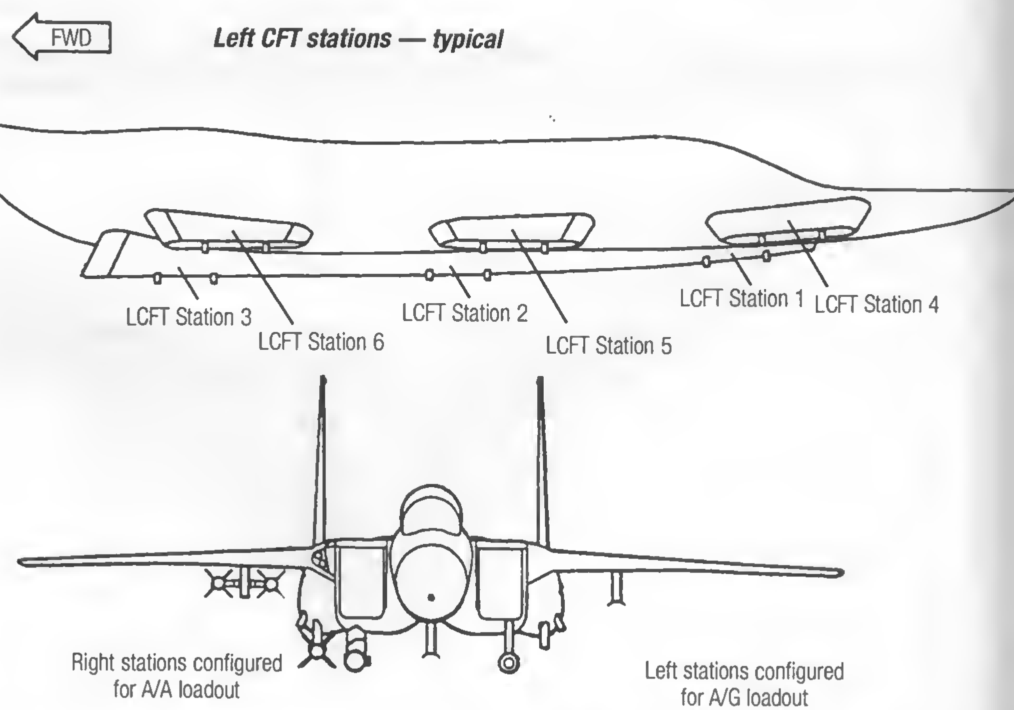
Item	Weight	Drag Number
F-15E with two CFTs (empty) and all other default load (no fuel)	37,000	20.1
Max fuel without external tanks	23,200	internal
610-Gallon External Fuel Tank	(empty) 320 (full) 4220	9.1
Gun ammunition (500 rounds)	included	internal
AN/ALE-40 Chaff/Flare Dispenser	included	internal
LANTIRN Nav Pod	520	9.5
LANTIRN Targeting Pod	621	7.4
AN/AXQ-14 Data Link Pod	450	4.6
AIM-7F	500	2.3
AIM-7M	507	2.3
AIM-9L, -9M, -9P	192	2.1
AIM-120A	346	2.0
AGM-65D	485	3.7
AGM-65G	675	3.7
BLU-107 Durandal	408	1.2
CBU-52, -58, -58A, -71, -71A	816	4.6
CBU-87	968	2.9
CBU-97	992	2.9
GBU-10	1980	9.3
GBU-10E, -10G	1984	9.3
GBU-12	492	3.9
GBU-12D	496	3.9
GBU-15(V)-1, -2, -31, -32	2513	5.6
GBU-24, -24A	1984	6.3
GBU-28	4695	7.0
Mk 20 Rockeye	489	1.5
Mk 82	531	0.8
Mk 82 AIR (with fin)	560	1.1
Mk 84	1970	2.7
Mk 84 AIR (with fin)	2010	4.9

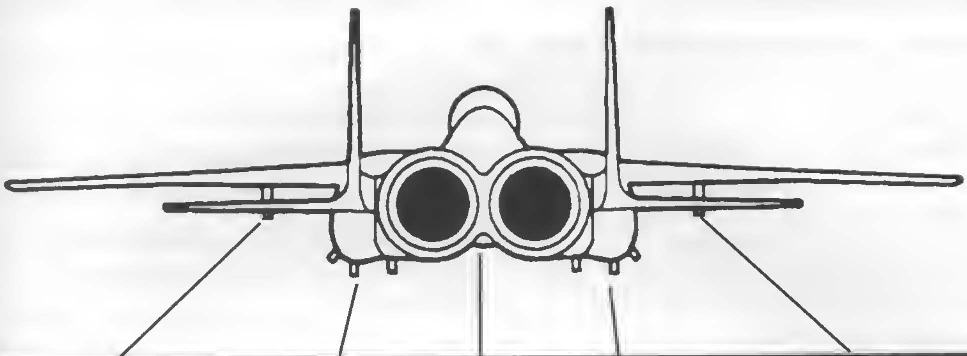
Allowable Stations/Weapons

There are (roughly) eleven stations for stores on an F-15E. (See facing page.) You can't mix weapons on a station, not even very similar weapons. (For example, you cannot load a mix of CBU-71s and CBU-71As on Station 4.) However, the wings have three stations, designated as Stations 2A, 2 and 2B (left wing) and 8A, 8 and 8B (right wing). Stations 2 and 8 can only carry A/G weapons (or a fuel tank). Stations 2A, 2B, 8A and 8B can only carry an air-to-air missile; each missile can be different.

Conversely, the weapons on Stations 3 and 4 (left CFT, outboard and inboard) cannot be mixed, nor can the weapons on Stations 6 and 7 (right CFT, inboard and outboard).

You are not required to balance the aircraft with identical stores on opposing stations due to the CAS (controlled augmentation system) automatically equalizing the weight and moment imballences. For example, Station 2A can carry an AIM-120A, while station 8B carries an AIM-9L, or even nothing at all.





Left Wing Station 2A (A/A)	Left Wing Station 2 (A/G, fuel)	Left Wing Station 2B (A/A)	Left CFT Stations 3, 4 (A/A, A/G)	Centerline Station 5 (A/G, fuel, link)	Right CFT Stations 6, 7 (A/A, A/G)	Right Wing Station 8A (A/A)	Right Wing Station 8 (A/G, fuel)	Right Wing Station 8B (A/A)
AIM-9L	AGM-65D (3)	AIM-9L	AIM-7F (2)	Mk 84	AIM-7F (2)	AIM-9L	AGM-65D (3)	AIM-9L
AIM-9M	AGM-65G	AIM-9M	AIM-7M (2)	Mk 84 AIR	AIM-7M (2)	AIM-9M	AGM-65G	AIM-9M
AIM-9P	Mk 84	AIM-9P	AIM-120A (2)	GBU-10	AIM-120A (2)	AIM-9P	Mk 84	AIM-9P
AIM-120A	Mk 84 AIR	AIM-120A	8LU-107 (6)	GBU-10E	8LU-107 (6)	AIM-120A	Mk 84 AIR	AIM-120A
	GBU-10		C8U-52 (6)	G8U-10G	CBU-52 (6)		GBU-10	
	GBU-10E		CBU-58 (6)	G8U-12	C8U-58 (6)		G8U-10E	
	G8U-10G		CBU-58A (6)	GBU-12D	C8U-58A (6)		G8U-10G	
	G8U-12		C8U-71 (6)	G8U-24	C8U-71 (6)		G8U-12	
	GBU-12D		C8U-71A (6)	G8U-24A	CBU-71A (6)		GBU-12D	
	GBU-15(V)-1		CBU-87 (6)	Fuel Tank	C8U-87 (6)		GBU-15(V)-1	
	G8U-15(V)-2		C8U-97 (6)	AN/AXQ-14	CBU-97 (6)		G8U-15(V)-2	
	G8U-15(V)-31		G8U-10 (2)	(Data Link Pod)	GBU-10 (2)		G8U-15(V)-31	
	GBU-15(V)-32		G8U-10E (2)		GBU-10E (2)		GBU-15(V)-32	
	G8U-24		GBU-10G (2)		GBU-10G (2)		GBU-24	
	G8U-24A		G8U-12 (4)		G8U-12 (4)		G8U-24A	
	G8U-28		G8U-12D (4)		G8U-12D (4)		GBU-28	
	Fuel Tank		Mk 20 (6)		Mk 20 (6)		Fuel Tank	
			Mk 82 (6)		Mk 82 (6)			
			Mk 82 AIR (6)		Mk 82 AIR (6)			
			Mk 84 (2)		Mk 84 (2)			
			Mk 84 AIR (2)		Mk 84 AIR (2)			

Note: Numbers in parentheses indicate how many weapons of that type can be carried on that station. Parenthetical numbers for the two pairs of CFT stations (3 and 4, and 6 and 7) indicate how many weapons of that type can be carried on the two stations combined.

Ordnance

For specific stats on each of these weapons, see **Weapons**, p. 224.

Air-to-Air

AIM-7F/M Sparrow. Semi-active radar-guided, all-aspect, medium-range missile (aircraft provides continuous radar lock)

AIM-9L/M Sidewinder. IR-guided, all-aspect, short-range missile (no post-launch guidance required)

AIM-9P Sidewinder. IR-guided, short-range missile (rear-aspect; no post-launch guidance required)

AIM-120 AMRAAM. Radar-guided, all-aspect, medium-range missile (minimum post-launch guidance required)

Air-to-Ground (Unguided)

BLU-107. Penetrating runway bomb (15kg HE warhead)

BSU-49 (Mk 82 AIR). Low-altitude, high-drag bomb for small targets (Mk 82 fitted with retard fins)

BSU-50 (Mk 84 AIR). Low-altitude, high-drag bomb for large targets (Mk 84 fitted with retard fins)

CBU-52/58/71. Cluster bomb for wide-area anti-personnel/soft target attacks (frag bomblets)

CBU-58A/71A. Incendiary version of CBU-58/71

A cluster bomb explodes above the the ground into smaller bomblets that then detonate upon impact.

CBU-87. Cluster bomb for wide-area attacks on anti-personnel/soft target attacks (frag bomblets with individual retard parachutes)

CBU-97. Cluster bomb for wide-area anti-armor attacks (frag bomblets with individual IR-guided warheads and retard parachutes)

Mk 20 Rockeye II. General purpose cluster bomb for anti-armor attacks

Mk 82. Gen. purpose, low-drag bomb (190kg warhead)

Mk 84. Gen. purpose, low-drag bomb (428kg warhead)

Air-to-Ground (Guided)

AGM-65D. IIR-guided missile

AGM-65G. IIR-guided missile with larger warhead

GBU-10/10E. Laser-guided bomb for precision attacks on large ground targets

GBU-10G. Penetrator version of GBU-10 for attacks on hardened structures

GBU-12/12D. Laser-guided bomb for precision attacks on small buildings or vehicles

GBU-15(V)-1. Standoff (long-range) bomb for precision attacks on large targets

GBU-15(V)-2. As -1, but with IIR camera for night use

GBU-15(V)-31. Standoff (long-range) bomb for precision attacks on large, hardened targets

GBU-15(V)-32. As -31, but with IIR camera for night use

GBU-24. Laser-guided bomb for close, precision attacks on large targets and runways

GBU-24A. As above, but for large, hardened targets

GBU-28. Laser-guided bomb for precision attacks on deep underground bunkers

Fuel Quantities

F-15Es in the game always fly with Conformal Fuel Tanks (CFTs). Therefore, the minimum fuel capacity is always 23,200 pounds. Each of the three external tanks that can be added weigh 320 pounds (empty), and can carry 3900 pounds of fuel. Therefore, the possible fuel configurations are listed on the last four lines of the following table (under **Combinations**).

Of course, it is not necessary to fill your aircraft to capacity. Fuel can be added or removed in 800-pound increments. The more fuel you have, the farther you can fly, but the harder it is to take off and maneuver.

Individual Tanks

Tank	Gallons	Pounds
A) Tank 1	604	4000
B) Tank 2 (Right Engine Feed)	234	1600
C) Tank 3 (Left Engine Feed)	189	1300
D) Right Internal Wing Tank	496	3300
E) Left Internal Wing Tank	496	3300
F) Right Conformal Tank	728	4850
G) Left Conformal Tank	728	4850
H) Right External Wing Tank	610	3900
I) Left External Wing Tank	610	3900
J) External Centerline Tank	610	3900

Combinations

Tank Combinations	Gallons	Pounds
Internal and Conformal Tanks (A-G)	3475	23,200
Internal, Conformal and Centerline Tanks (A-G, J)	4085	27,100
Internal, Conformal and Wing Tanks (A-I)	4695	31,000
Max Fuel — all tanks (A-J)	5305	34,900

Default Player Loadouts

In the Arming screen, you can configure your F-15E with one of the default loadouts. Or, you can create your own. (To modify a default loadout, load it onto an aircraft, then select CUSTOM to alter individual stations.) The intent of this section is to explain the benefits and best applications for each bomb and missile loadout. (Machine gun ammunition types are ignored, since M56A3 and PGU-28/B rounds are nearly identical from a tactical standpoint.)

The best rule-of-thumb for determining which loadout to carry is to consider your target type, as well as any information you get in the briefing. If you're ordered to destroy a runway, but not the friendly, hijacked plane sitting on top of it, you're going to want a loadout with guided GBU-10Gs or BLU-107s. If you want to demolish everything in sight, your best bet is a full rack of Mk 82 or Mk 84 dumb bombs.

Another point to consider is that you're often flying with wingmen. If you prefer that your wingman handle air targets while you drop bombs, pick an air-to-ground loadout for yourself and load him up with A/A ordnance. No matter what loadout you choose, remember that loadouts for all aircraft in the entire flight should complement each other. Don't load four aircraft up for a strike mission and forget to give them air-to-air weapons — instead, load three up with A/G ordnance and arm a fourth with as much A/A ordnance as it can carry, or give each aircraft a couple of missiles. (Certain stations can only carry air-to-air weapons, and remain empty if you don't load them.)

See **Weapons**, p. 224, for detailed statistics on each weapon type and **Weapon Advisor**, p. 209, for a cross-comparison chart of loadouts and weapon types.

The default player loadouts are listed on p. 230, along with all the other default loadouts in the game. They are repeated here, so that additional information can be given, and so that the best use of each loadout can be discussed.

In addition to the columns in the other default loadout table (**Equipment**, **Gun**, **A/A** and **A/G**), this table includes **ExT** (how many external fuel tanks are carried in addition to the CFTs), **Fuel** (how many total pounds of fuel are on board at takeoff), **Wt** (the takeoff weight of the F-15E with each loadout) and **DI** (the drag index of the F-15E before any stores have been expended). (For more information on **Drag Index and Weight**, see p. 210.)

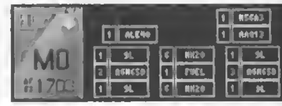
LOADOUT[1]	Equipment	Gun[2]	A/A	A/G	ExT	Fuel	Wt	DI
CAS (p. 218)	AN-AAQ-13	M56A3	AIM-9L (4)	AGM-65D (6) Mk 20 (12)	1	25,500	72,887	87.3
Deep Attack (p. 218)	AN-AAQ-13	M56A3	AIM-9L (4)	Mk 84 (4)	3	33,300	80,429	76.1
Interdiction (p. 218)	AN-AAQ-13	M56A3	AIM-9L (4)	Mk 82 (12)	3	34,900	80,521	74.9
Runway (p. 219)	AN-AAQ-13	M56A3	AIM-9L (4)	BLU-107 (12)	3	34,900	79,045	79.7
Smart Bomb (p. 219)	AN-AAQ-13, -14	M56A3	AIM-9L (4)	GBU-10G (3)	2	31,000	76,502	91.5
Standoff (p. 219)	AN-AAQ-13, AN/AXQ-14	M56A3	AIM-7F (2) AIM-9L (4)	GBU-15(V)-1 (2)	0	21,600	66,365	58.4
Long CAS (p. 220)	AN-AAQ-13, -14	PGU-28/B	AIM-120A (2) AIM-9M (2)	Mk 20 (12)	2	31,000	76,726	81.4
MiGCAP (p. 220)	AN-AAQ-13, -14	PGU-28/B	AIM-120A (4) AIM-9M (4)		2	31,000	71,933	71.6
Runway 2 (p. 220)	AN-AAQ-13, -14	PGU-28/B	AIM-120A (2) AIM-9M (2)	BLU-107 (12)	2	31,000	75,754	77.8
Smart Bomb 2 (p. 221)	AN-AAQ-13, -14	PGU-28/B	AIM-120A (2) AIM-9M (2)	GBU-10G (3)	2	31,000	76,810	91.3
Standard (p. 221)	AN-AAQ-13, -14	PGU-28/B	AIM-120A (2) AIM-9M (2)	AGM-65D (6) Mk 20 (12)	1	27,100	75,920	94.5
Strike (p. 221)	AN-AAQ-13, -14	PGU-28/B	AIM-120A (2) AIM-9M (2)	BSU-50 (5)	2	27,800	77,508	88.0

This chart assumes the specified stores are available. This is not always the case in a campaign.

[1] All default loadouts contain chaff (60) and flares (90).

[2] Both ammunition types are 20mm, and loadouts of each contain 500 rounds.

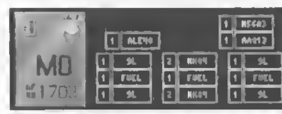
CAS



The Close-Air Support (CAS) loadout is preferably used against a conglomeration of objects, when collateral damage isn't a concern. It includes imaging IR-guided A/G missiles (6 AGM-65Ds) and dumb cluster bombs (12 Mk 20s).

The AGM-65s are primarily for hitting small targets, such as tanks or threatening SAM and AAA sites. The Mk 20s can be ripple-released over a series of small buildings, grounded aircraft or other targets that are fairly easy to identify visually. The CAS loadout is best-suited for daytime use. For night missions, consider using Long CAS — it has the AN/AAQ-14 targeting pod by default.

Deep Attack



The Deep Attack loadout gives you a good mix of A/A and A/G weapons. This loadout is good if you're not quite sure what you're going to find during your mission, but you're fairly certain you won't need armor-penetrating weapons. The four Mk 84s will let you make one or two runs against unarmored targets. The four AIM-9Ls give you only short-range air attack capabilities, however.

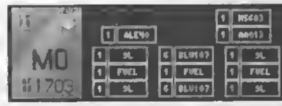
You aren't going to want to take this loadout if your attack needs to be extremely precise, but if you want to strike quickly with a ripple-release of powerful bombs, the Deep Attack will suit your needs just fine.

Interdiction

The distinguishing factor for this loadout is its three external fuel tanks, which allow you to travel much further than you can with internal and CFT fuel alone. Use this loadout if you plan to hit a group of small, unarmored targets deep in enemy territory. Don't use it if you're trying to hit a specific target and don't want to damage anything else in the immediate vicinity.

The twelve dumb Mk 82s you have onboard should serve your purpose just fine, as long as you aren't too concerned about hitting the mark. The loadout includes four short-range Sidewinder missiles as well. As long as you utilize your wingman's weapons and the weapons of any other flight accompanying you, air threats won't pose much of a problem.

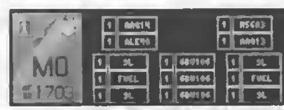
Runway



The name of this loadout speaks for itself — it's designed for runway strikes. With a dozen BLU-107s, you should be able to ripple-release your way through the airfield in a single run. And since not many enemy airfields are close to the battle line, you have three external fuel tanks to get there. Just in case fighters scramble, you've also got four short-range, IR-guided AIM-9Ls.

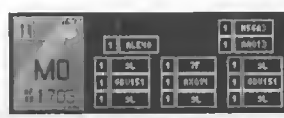
This firepower loadout is best-suited for a low-altitude bombing run. You can glide in below SAM range, but you'll still face AAA fire. If a SEAD flight is available in an airfield bombing mission, take advantage of it, and take this loadout.

Smart Bomb



The trio of GBU-10Gs in this loadout are suitable for one or two runs against a specific, hardened target. The AN/AAQ-14 targeting pod contains the laser designator needed to guide the GBU-10Gs and an IR camera to help you ID targets at night. For the trip home, you have 4 AIM-9Ls for self-defense.

Standoff

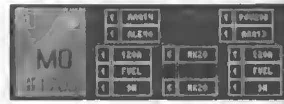


You almost always have to penetrate enemy airspace in order to make an attack on an assigned target. If the target is heavily defended by SAMs and AAA, you're not going to want to get too close. In this case, consider taking the Standoff loadout. It gives you two medium-range AIM-7Fs, as well as four short-range AIM-9Ls — they'll help you get to the target area.

As for ground targets, reserve this loadout for *large* targets! A single GBU-15 (1) can take out a bridge, building, hangar or ship, so needless to say, you aren't going to want to waste one on a SAM site. The TV-guidance system (housed in the AN/AXQ-14 pod) allows you to drop this bomb from standoff range (thus, the name "standoff").

It's worth noting that this is the only loadout that includes the AN/AXQ-14 datalink pod by default. You can use this to view data-linked camera images in the Weapon Video MPD from the seeker head of the GBU-15 after weapon release. Using this pod, you can even provide some manual steering input to the weapon after release. (See the *Expert Flight Manual*, p. 4.67.)

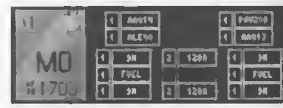
Long CAS



Like the CAS loadout, the Long CAS contains 12 Mk 20s. However, the four AIM-9L Sidewinders have been unloaded in favor of two AIM-120s and two AIM-9Ms, giving you medium- and short-range A/A capabilities. Also, the AGM-65Ds of the CAS loadout have been replaced by a pair of external fuel tanks and the AN/AAQ-14 targeting pod has been added to the default.

Use this loadout for long-range attacks against small, unarmored targets, and when you fear facing a flight or two of enemy aircraft on the way in or out.

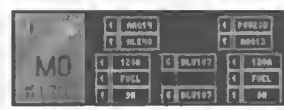
MiGCAP



If you've done your homework, you know that a flight assigned a MiGCAP isn't assigned any ground targets. Therefore, this loadout consists of all A/A weapons — four AIM-120s and four AIM-9Ms. (There's not a huge difference between AIM-9Ms and AIM-9Ls. It's more a matter of personal preference, and of course, available inventory.)

Assuming you have some proficiency in air-to-air combat, you should easily be able to handle any MiGs you run across with this loadout.

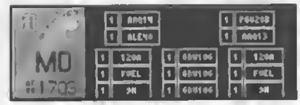
Runway 2



Like its cousin Runway loadout, Runway 2 carries a full complement of BLU-107 Durandal runway bombs. However, it has only two external underwing fuel tanks instead of three. Another difference between the two loadouts is that Runway 2 has two AIM-9M Sidewinders and a pair of AIM-120 AMRAAMs instead of four AIM-9L Sidewinders. This means you have both short-range and medium-range missiles at your disposal. Unlike the Runway loadout, Runway 2 also has the LANTIRN targeting pod and laser. This makes it a good choice for night-based missions, since you can use the LANTIRN's FLIR pod image to pick out targets.

Despite its air-to-air ordnance, Runway 2 is strictly for striking airfields. The air-to-air weapons are loaded so that you can fight off any intercept flights you meet along the way, not so that you can hunt down enemy aircraft. Opt for this loadout if you suspect that fighters will intercept you, and you don't have a full-fledged escort flight to protect you.

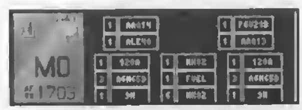
Smart Bomb 2



Smart Bomb 2 is almost identical to Runway 2, except for the fact that it loads GBU-10Gs instead of BLU-107s.

You can use this loadout if you're planning on hitting runways or large, hardened buildings. It's also well-suited to nighttime missions since it has the AN/AAQ-14 FLIR targeting and laser pod. The GBU-10G, unlike the E-model, has a penetrator warhead that can puncture fortified bunkers and heavily armored hangars. The accuracy provided by laser-guidance makes this loadout an obvious choice if you're trying *not* to hit something near your actual target.

Standard



If you're going on a run-of-the-mill bombing mission, then Standard is the loadout for you. You've got short-range AIM-9M Sidewinders and medium-range AIM-120 AMRAAMs to help you get there and get out safely, and a full complement of air-to-ground weapons. Half of the complement consists of six AGM-65D Maverick missiles, perfect for disposing of SAM and AAA sites. The other half consists of twelve Mk 82 dumb bombs. Last but not least, there's an extra fuel tank to ensure that you go the distance.

The Standard loadout is best applied when you know you're going to be facing surface-to-air missiles and triple-A fire, and when your intended target is something that requires the raw explosive power of the Mk 82s. Dumb bombs aren't all that accurate when you're trying to take out smaller threats, but guided missiles are. You'll breath a sigh of relief when you can ripple-fire a few guided AGM-65Ds at SAMs lurking near the target area.

Strike

The Strike package contains five general-purpose Mk 84s, along with standard loadout fare — two AIM-9M Sidewinders and two AIM-120 AMRAAMs to get you there, and two external fuel tanks to get you back.

You should use this general ground strike loadout when you're making a long journey across the fence line to hit one or two specific targets. You shouldn't use it if you want to hit a lot of secondary targets, or if you want to avoid collateral damage.

GAME STATS

Aircraft Stats

Many of the stats in this table are only rough values, since they vary by altitude, loadout and other factors, and some have been rounded to the nearest thousand. Use these numbers for relative comparisons, rather than absolute values.

Loadout pg. The page in this book that lists thc aircraft's possible loadouts.

Max Spd. Maximum indicated airspeed, in knots.

Stall Spd. The speed at which the aircraft begins to stall, in knots.

Accel. Acceleration, in knots per second.

Max Turn. The greatest heading change the aircraft can make (degrees per sec).

Max Gs. The aircraft's structural limit, in Gs.

Wt. The aircraft's approximate weight.

Ceil. The aircraft's maximum possible altitude.

Afterburn? Whether the aircraft has afterburners.

Radar Vis. Relative measure of how visible the aircraft is to radar (1 least; 10 greatest).

Radar. Type of radar the aircraft carries.

Engine(s). How many engines the aircraft mounts, and whether they are wing-mounted or rear-mounted.

Fighters

Aircraft (loadout pg)	Max Spd.	Stall Spd.	Accel.	Max Turn	Max Gs	Wt.	Ceil.	After burn?	Radar Vis.	Radar	Engine(s)
F-14 (233)	1000	140	12	15	9	55k	53k	Yes	5	AWG-9 (F-14)	2 (rear)
F-15C (231)	1000	150	12	15	9	40k	65k	Yes	5	APG-70 (F-15)	2 (rear)
MiG-21 (233)	800	160	9	12	8	16k	50k	Yes	4	Spin Scan (MiG-21)	1 (rear)
MiG-23 (234)	900	150	11	13	8	35k	60k	Yes	6	High Lark (MiG-23)	1 (rear)
MiG-25 (234)	1200	170	13	12	5	50k	70k	Yes	6	Foxfire (MiG-25)	2 (rear)
MiG-29 (234)	1000	150	12	15	9	33k	55k	Yes	5	Slot Back (MiG-29)	2 (rear)
Mirage (234)	900	150	11	14	8	27k	66k	Yes	5	Cyrano IV (F-1)	1 (rear)
Su-27 (235)	1000	150	12	15	9	33k	55k	Yes	5	Slot Back (Su-27)	2 (rear)

Bombers

Aircraft (loadout pg)	Max Spd.	Stall Spd.	Accel.	Max Turn	Max Gs	Wt.	Ceil.	After burn?	Radar Vis.	Radar	Engine(s)
B-52G (235)	520	170	6	9	3	38k	55k	No	9	B-52 (Tail Gun Radar)	4 (wing)
EA-6B (235)	570	160	8	12	5	45k	38k	No	5	none	2 (rear)
EF-111 (235)	850	140	9	12	6	70k	51k	Yes	6	none	2 (rear)
F-117A (236)	560	160	6	12	6	45k	45k	No	1	none	2 (rear)
Tu-22 (235)	700	150	9	11	5	190k	60k	Yes	8	Tu-22 (Tail Gun Radar)	2 (rear)

Fighter/Bombers

Aircraft (loadout pg)	Max Spd.	Stall Spd.	Accel.	Max Turn	Max Gs	Wt.	Ceil.	After burn?	Radar Vis.	Radar	Engine(s)
F-4E (237)	900	150	12	12	7	45k	28k	Yes	5	AN/APQ-153 (F-4E)	2 (rear)
F-4G (233)	900	150	12	12	7	45k	28k	Yes	5	AN/APQ-120 (F-4E)	2 (rear)
F-5E (236)	850	125	9	15	7	24k	50k	Yes	4	AN/APQ-153 (F-5E)	2 (rear)
F-111 (236)	1000	140	9	12	6	75k	51k	Yes	6	AN/APQ-144 (F-111)	2 (rear)
F-15E (231)	1000	150	12	15	9	50k	65k	Yes	5	APG-70 (F-15)	2 (rear)
F-16 (232)	1000	150	11	16	9	27k	53k	Yes	4	APG-68 (F-16)	1 (rear)
F/A-18 (232)	800	150	11	15	9	45k	50k	Yes	4	APG-65 (F/A-18)	2 (rear)
Jaguar (232)	700	150	9	13	8	25k	45k	Yes	5	none	2 (rear)
MiG-35 (237)	1000	150	12	15	9	33k	55k	Yes	5	Zhuk-PH (MiG-35)	2 (rear)
Su-22 (236)	900	160	8	12	9	38k	50k	Yes	4	High Fix (Su-22)	1 (rear)
Su-24 (236)	900	140	11	13	6	90k	5k	Yes	5	Orion A (Su-24)	2 (rear)
Su-25 (235)	600	150	7	12	6	30k	23k	No	4	none	2 (rear)
Su-35 (231)	1000	150	13	15	9	3k	55k	Yes	5	Zhuk-PH (MiG-35)	2 (rear)
Tornado (231)	900	140	11	13	7	45k	70k	Yes	5	Doppler 72 (Tornado)	2 (rear)

C&C

Aircraft (load p. 233)	Max Spd.	Stall Spd.	Accel.	Max Turn	Max Gs	Wt.	Ceil.	After burn?	Radar Vis.	Radar	Engine(s)
A-50	460	160	5	7	2	250k	59k	No	10	AWACS (AN/APY-1/2)	4 (wing)
E-3 AWACS	460	160	6	8	2	250k	29k	Yes	10	AWACS (AN/APY-1/2)	4 (wing)
E-8 JSTARS	460	160	6	8	2	250k	42k	No	9	none	4 (wing)

Transports

Aircraft (loadout pg)	Max Spd.	Stall Spd.	Accel.	Max Turn	Max Gs	Wt.	Ceil.	After burn?	Radar Vis.	Radar	Engine(s)
AC-130 (237)	350	150	3	5	3	125k	27k	No	9	none	4 (wing)
C-130 (233)	350	100	3	5	3	125k	27k	No	9	none	4 (wing)
C-17 (233)	370	160	6	8	3	350k	45k	No	9	none	4 (wing)
KC-135 (233)	465	150	6	8	2	200k	40k	No	9	none	4 (wing)

Civilian

Aircraft (no loadout)	Max Spd.	Stall Spd.	Accel.	Max Turn	Max Gs	Wt.	Ceil.	After burn?	Radar Vis.	Radar	Engine(s)
707	535	105	6	8	2	250k	39k	No	9	none	4 (wing)
Il76	460	160	5	7	2	250k	59k	No	9	none	4 (wing)

Helicopters

Aircraft (loadout pg)	Max Spd.	Stall Spd.	Accel.	Max Turn	Max Gs	Wt.	Ceil.	After burn?	Radar Vis.	Radar	Engine(s)
AH-64 (232)	200	n.a.	6	15	7	20k	16k	No	4	none	2 (rear)
MH-53J (233)	150	n.a.	6	15	2	20k	16k	No	4	none	2 (rear)
Mi-24 (237)	175	n.a.	6	15	3	20k	16k	No	4	none	2 (rear)
Mi-8 (237)	135	n.a.	6	15	3	20k	16k	No	4	none	2 (rear)

Weapons

There are 15 categories of statistics in this table, but only a few apply to every type of weapon. For example, only cluster bombs have entries for **Number of Bomblets** or **Sub-Weapon**, and only guided weapons will have a **Seeker** entry. For each type of weapon, only the applicable statistics will be listed.

Many of the stats in this table are only rough values, since they vary by altitude, speed of launching aircraft, and other factors, and some have been rounded to the nearest thousand. Use these numbers for relative comparisons, rather than absolute values.

MPD Abbrev. How the weapon is identified on the F-15E MPD.

TEWS. The TEWS identification code (if any).

Max. Spd. The weapon's maximum speed, in Mach numbers.

Max. Alt. The highest altitude at which the weapon can operate (if air-launched) or which the weapon can reach (if surface-launched), in thousands of feet.

Max Range. The maximum horizontal range of the weapon, in nautical miles.

Rate of Fire. The number of rounds per minute the weapon can fire.

Volley. The number of rounds that can be fired before the weapon must be reloaded.

Min. Range. The minimum possible range at which the weapon can gain a lock on a target.

Seeker. The weapon's guidance system. (IR = infrared; SARH = Semi-Active Radar Homing.)

Dam. Val. How much damage the weapon can inflict (in damage points). See **Damage System**, p. 240.

Dam. Rad. A measure of the area subject to damage, measured from the point of impact, in feet. See **Damage System**, p. 240.

Number of Bomblets. The number of bomblets into which the weapon splits.

Sub-Weapon. What the bomblets are. Cluster bomb sub-weapons are listed under *Unguided Bombs*.

AAA

	Seeker	Dam. Val.	Dam. Rad.	Rate of Fire	Volley	Max Range	Max Alt.
100mm	Single	4	4	15	100	9	45k
23mm	Stream	1	1	200	50	1	7k
37mm	Burst	2	1	80	5	3	10k
85mm	Single	3	3	17	150	7	28k
AA MG (12.7mm)	Burst	1	1	90	60	1	3k
OSA 2 30mm	Burst	4	2	1000	120	2	10k
ZSU-2-57	Burst	3	2	70	4	4	16k
ZSU-4-23	Stream	3	1	200	30	2	7k

A/A Missiles

	Seeker	TEWS	Dam. Val.	Dam. Rad.	Max Range	Min Range	Max Spd.	Max Alt.
AA-10 Alamo (CW)	SARH	51	86	213	27	1	3.5	70k
AA-10 Alamo (IR)	IR (all)	50	86	213	22	1	3.5	70k
AA-11 Archer	IR (all)	50	16	49	11	—	2.2	70k
AA-2 Atoll	IR (rear)	50	24	56	2	—	2	50k
AA-8 Aphid	IR (all)	50	13	49	3	—	2.5	70k
AIM-120A AMRAAM	Radar	52	49	164	33	3	4	80k
AIM-54 Phoenix	Radar	—	80	200	65	2	5	80k
AIM-7F Sparrow	SARH	51	86	213	20	2	3.7	—
AIM-7M Sparrow	SARH	51	86	213	24	2	3.7	80k
AIM-9L Sidewinder	IR (all)	50	25	66	10	—	2.5	70k
AIM-9M Sidewinder	IR (all)	50	25	66	10	—	2.5	70k
AIM-9P Sidewinder	IR (rear)	50	25	66	4	—	2.4	70k
Matra R 530	SARH	51	66	197	22	3	4.8	80k
Matra R 550 Magic	IR (rear)	50	29	66	2	—	2.5	70k
SA-7 (Hel. AAM)	IR (rear)	7	4	3	2	—	1.2	10k
AN/ALE-40 Dispenser	—	—	—	—	—	—	—	—

A/G Missiles

	Seeker	Dam. Val.	Dam. Rad.	Max Range	Min Range	Max Spd.
AGM-45 Shrike	Anti-Radar	75	150	10	—	2
AGM-65D Maverick	IR (imaging)	125	150	15	—	2
AGM-65G Maverick	IR (imaging)	250	500	18	—	2
AGM-88 HARM	Anti-Radar	75	150	10	—	2.5
AT-3 Anti-Armor	Video	25	10	2	—	1
SS-1 Scud "B"	—	600	600	151	—	6
SS-N-2A Styx	Radar	200	300	25	3	0.9

Cluster Bombs

	Dam. Val.	Dam. Rad.	Number of Bomblets	Sub Weapon
CBU-52	*	400	217	BLU-63
CBU-58	*	200	650	BLU-63
CBU-58A	*	200	650	BLU-63A
CBU-71	*	200	650	BLU-86
CBU-71A	*	200	650	BLU-68
CBU-87	*	150	202	BLU-97
CBU-97	*	150	40	BLU-108
Mk 20 Rockeye II	*	125	247	Mk 118

* Varies based on release altitude — either widespread, relatively low damage, or concentrated, relatively high damage. (See **Cluster Bomblets**, next page.)

Unguided Bombs (Dumb Bombs)

	Seeker	Dam. Val.	Dam. Rad.
BLU-107 Durandal	—	33	25
Mk 82 AIR (BSU-49)	—	200	637
Mk 84 AIR (BSU-50)	—	800	812
Mk 82	—	200	637
Mk 84	—	800	812

Cluster Bomblets

	Seeker	Dam. Val.	Dam. Rad.
BLU-108	IR (imaging)	48	8
BLU-61	—	4	15
BLU-63	—	3	10
BLU-63A	—	3	10
BLU-68	—	3	10
BLU-86	—	3	10
BLU-97	—	6	14
Mk 118	—	4	15

Guided Bombs

	Seeker	Dam. Val.	Dam. Rad.
GBU-10 Paveway	Laser	800	812
GBU-10E Paveway II	Laser	800	812
GBU-10G Paveway II	Laser	500	528
GBU-12 Paveway I	Laser	200	637
GBU-12D Paveway II	Laser	200	637
GBU-15(V)-1	TV	800	812
GBU-15(V)-2	TV	800	812
GBU-15(V)-31	IR (imaging)	500	528
GBU-15(V)-32	IR (imaging)	500	528
GBU-24 Paveway III	Laser	800	812
GBU-24A Paveway III	Laser	500	528
GBU-28	Laser	700	400

Guns

	Dam. Val.	Dam. Rad.	Rate of Fire	Max Range
20mm tail cannon	2	3	4000	—
23mm cannon	2	2	3000	—
23mm tail cannon	2	3	3000	—
30mm cannon	3	3	1000	—
AC-130H 105 Howitzer	5	5	15	9
AC-130H 20mm Vulcan	2	3	4000	—
AC-130H 40mm Bofors	3	3	300	5
M56A3 20mm ammo	2	3	4000/6000	—
PGU-28/B 20mm ammo	3	3	4000/6000	—

SAMs

	Seeker	TEWS	Dam. Val.	Dam. Rad.	Volley	Max Range	Min Range	Max Spd.	Max Alt.
Hawk	SARH	30	119	82	3	17	1	2.7	45k
Roland	SARH	28	14	10	10	3	—	1.4	18k
SA-2	SARH	2	430	200	1	16	3	3.5	82k
SA-3	SARH	3	132	82	4	10	1	3.5	59k
SA-6	SARH	6	130	33	3	13	2	2.8	46k
SA-7	IR (rear)	7	3	3	1	2	—	1.2	8k
SA-8	SARH	8	44	33	6	5	1	2.4	16k
SA-9	IR (all)	9	6	33	4	4	—	1.8	20k
SA-10	SARH	10	293	148	4	54	3	6	98k
SA-11	SARH	11	154	79	4	18	2	3.5	72k
SA-13	IR (all)	13	7	33	4	3	—	2.3	11k
SA-14	IR (rear)	14	4	3	1	3	—	1.2	16k
SA-15	SARH	15	33	16	8	6	1	2.5	20k
SA-16	IR (all)	16	3	3	1	3	—	1.4	9k
SA-19	SARH	19	20	20	8	4	1	2.6	13k

Radars

TEWS Code. If the radar can have a readout on the F-15 TEWS screen, this is the identifying number that will appear.

Radar Type. STT (Single Target Track), TWS (Track While Scan), L/M/HPRF (Low/Medium/High Pulse Repetition Frequency), CW (Continuous Wave), O (Optical).

Range. The radar's range, in nautical miles.

Azimuth and **Elev**ation. The radar's horizontal and vertical arc, in degrees. Elevation is a more useful stat than azimuth — knowing a radar's elevation, you can know when you have flown close enough that it can no longer track you.

Rate. For SAMs, this is the number of missiles that can be fired in one volley. **Rate** does not apply to other radars.

Generation. The radar's relative "age" as far as its acquisition technology is concerned — a generation 1 radar has the oldest technology, while a generation 3 radar has the most advanced technology.

	TEWS Code	Radar Type	Range (nm)	Azim.	Elev.	Rate	Gen.
AN/APQ-120 (F-4E)	4	STT, CW	20	60	60	n.a.	2
AN/APQ-144 (F-111)	40	CW	5	60	60	n.a.	2
AN/APQ-153 (F-5E)	5	STT	19	60	60	n.a.	2
APG-65 (F/A-18)	18	STT, TWS, M/HPRF, CW	76	60	60	n.a.	3
APG-68 (F-16)	16	STT, TWS, L/M/HPRF, CW	80	60	60	n.a.	3
APG-70 (F-15)	15	STT, TWS, M/HPRF, CW	73	60	60	n.a.	3
AWACS (AN/APY-1/2)	—	LPRF	254	360	80	n.a.	3
AWG-9 (F-14)	14	STT, TWS, CW	90	60	60	n.a.	3
B-52 (Tail Gun Radar)	43	STT	2	20	20	n.a.	2
Bar Lock (GCI)	—	LPRF	162	360	85	n.a.	1
Cyrano IV (F-1)	1	STT, MPRF, CW	15	60	60	n.a.	2
Doppler 72 (Tornado)	41	STT, MPRF, CW	29	60	60	n.a.	2
Drum Tilt (OSA II Gun FCR)	55	STT	22	360	85	n.a.	1
Fan Song (SA-2)	2	STT, TWS, HPRF	40	360	85	3	1
Fire Can (AAA)	99	STT, O	19	360	90	n.a.	1
Fire Dome (SA-11 TELR)	11	STT, MPRF, CW	38	360	80	2	3
Flap Lid (SA-10)	10	STT, TWS, MPRF	64	360	50	2	3

	TEWS Code	Radar Type	Range (nm)	Azim.	Elev.	Rate	Gen.
Flash Dance (MiG-31)	31	STT, TWS, CW	65	60	60	n.a.	3
Flat Face (GCI)	—	LPRF	100	360	85	n.a.	1
Foxfire (MiG-25)	25	STT, CW	27	60	60	n.a.	2
Gauntlet (SA-15)	15	STT, TWS, MPRF	13	360	85	2	3
Gun Dish (ZSU-4-23)	23	STT, O	10	360	90	n.a.	1
Hawk	30	STT, TWS, MPRF, CW	22	360	85	1	3
High Fix (Su-22)	22	CW	8	60	60	n.a.	1
High Lark (MiG-23)	23	STT, CW	29	60	60	n.a.	2
Hot Shot (SA-19)	19	STT, TWS, MPRF, O	10	360	90	1	3
Land Role (SA-8)	8	STT, TWS, HPRF, O	13	360	85	2	2
Low Blow (SA-3)	3	STT, TWS, HPRF	43	360	85	2	1
Orion A (Su-24)	24	CW	5	60	60	n.a.	2
Roland	28	STT, TWS, MPRF, O	9	360	85	1	3
Slot Back (MiG-29)	29	STT, TWS, MPRF, CW, O	38	60	60	n.a.	3
Slot Back (Su-27)	27	STT, TWS, L/M/HPRF, CW, O	38	60	60	n.a.	3
Slot Back (Su-30)	30	STT, TWS, L/M/HPRF, CW, O	38	60	60	n.a.	3
Snap Shot (SA-13)	13	STT, HPRF, O	5	30	85	2	2
Snow Drift (SA-11)	12	STT, TWS, MPRF	54	360	85	1	3
Spin Scan (MiG-21)	21	STT, CW	8	60	60	n.a.	1
Square Tie (OSA Styx Fire Control)	55	(groundsweep, only)	25	0	0	n.a.	n.a.
Straight Flush (SA-6)	6	STT, HPRF, CW	16	360	85	3	2
Su-25	25	STT, CW	29	60	60	n.a.	2
Tu-22 (Tail Gun Radar)	42	STT	2	20	20	n.a.	2
Zhuk-PH (MiG-35)	35	STT, TWS, L/M/HPRF, CW, O	38	60	60	n.a.	3

Aircraft Loadouts

The aircraft you encounter can each carry a variety of loadouts. Some stores (particularly guns, dispensers and jammers) are usually consistent across all of an aircraft's loadouts. Others (particularly missiles and A/G munitions) vary significantly among an aircraft's loadouts.

Each aircraft's possible loadouts are included in the following list. While you won't know for sure which loadout an aircraft is carrying when you encounter it (unless you examined the aircraft before the mission, using the Mission Builder), this list does give you the range of possibilities, and that is usually all you need to know. ***Note:*** *Most aircrafts also have an* ***Empty*** *loadout, with means the aircraft carries no weapons.*

Since **chaff** and **flares** never change for a specific aircraft, those numbers are listed on the first line of each aircraft. (Of course, you *can* modify your own aircraft's chaff and flare loadout.) All other crucial stores are listed in the appropriate column (**Equipment**, **Gun**, **A/A** and **A/G**).

For more info on player-aircraft loadouts, see **Player Aircraft Stats**, p. 209.

F-15E Player — chaff (60), and flares (90)

LOADOUT	Equipment	Gun [1]	A/A [2]	A/G [2]
CAS	AN-AAQ-13	M56A3	AIM-9L (4)	AGM-65D (6) Mk 20 Rockeye II (12)
Deep Attack	AN-AAQ-13	M56A3	AIM-9L (4)	Mk 84 (4)
Interdiction	AN-AAQ-13	M56A3	AIM-9L (4)	Mk 82 (12)
Runway	AN-AAQ-13	M56A3	AIM-9L (4)	BLU-107 Durandal (12)
Smart Bomb	AN-AAQ-13, -14	M56A3	AIM-9L (4)	GBU-10G Paveway II (3)
Standoff	AN-AAQ-13, AN/AXQ-14	M56A3	AIM-7F (2) AIM-9L (4)	GBU-15(V)-1 (2)
Long CAS	AN-AAQ-13, -14	PGU-28	AIM-120A (2) AIM-9M (2)	Mk 20 Rockeye II (12)
MiGCAP	AN-AAQ-13, -14	PGU-28	AIM-120A (4) AIM-9M (4)	
Runway 2	AN-AAQ-13, -14	PGU-28	AIM-120A (2) AIM-9M (2)	BLU-107 Durandal (12)
Smart Bomb 2	AN-AAQ-13, -14	PGU-28	AIM-120A (2) AIM-9M (2)	GBU-10G Paveway II (3)
Standard	AN-AAQ-13, -14	PGU-28	AIM-120A (2) AIM-9M (2)	AGM-65D (6) Mk 20 Rockeye II (12)
Strike	AN-AAQ-13, -14	PGU-28	AIM-120A (2) AIM-9M (2)	Mk 84 AIR (5)

[1] All gun loadouts for this aircraft feature 512 rounds of 20mm ammunition.

[2] Numbers in parentheses indicate how many weapons of that type can be carried on that station.

F-15E — chaff (120), flares (60)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only		PGU-28		
CAP		M56A3	AIM-9L (4)	
Interdiction		M56A3		Mk 82 (4)
4 Mk 84s …		M56A3	AIM-7F (2) AIM-9L (2)	Mk 82 (4)
Mk 82 …		M56A3	AIM-7F (2) AIM-9L (2)	Mk 82 (12)
Rear Aspect IR		M56A3	AIM-9P (4)	
All Aspect IR		M56A3	AIM-9M (4)	
SARH		M56A3	AIM-7M (4)	
Active Radar Missiles		M56A3	AIM-120A (4)	

Tornado — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		30mm(180)		
Bomb Loadout		30mm (180)		Mk 82 (8)
Rear Aspect IR		30mm (180)	AIM-9P (4)	
All Aspect IR		30mm (180)	AIM-9M (4)	
British LGB/AAM	internal jammer	30mm (180)	AIM-9L (2)	GBU-10E Paveway II (2)
British SEAD Load	internal jammer	30mm (180)	AIM-9L (2)	ALARM (3)
Runway Attack	internal jammer	30mm (180)	AIM-9L (2)	BLU-107 Durandal (6)

F-15C Eagle — chaff (120), flares (60)

LOADOUT	Equipment	Gun [2]	A/A	A/G
Guns Only		M56A3		
Rear Aspect IR		M56A3	AIM-9P (4)	
All Aspect IR		M56A3	AIM-9M (4)	
SARH		M56A3	AIM-7M (6)	
Active Radar Missiles		M56A3	AIM-120A (6)	
Full Anti-Air Load		M56A3	AIM-7M (4) AIM-9M (4)	
Early DS Eagle Load		M56A3	AIM-7F (4) AIM-9L (4)	
Late DS Eagle Load		M56A3	AIM-7M (4) AIM-9M (4)	

[2] All gun loadouts for this aircraft feature 940 rounds of 20mm ammunition.

Su-35 Flanker — chaff (60), flares (30)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only	internal jammer	30mm (149)		
Rear Aspect IR	Internal jammer	30mm (149)	AA-2 Atoll (R-131) (10)	
All Aspect IR	internal jammer	30mm (149)	AA-11 Archer (R-73) (2) AA-8 Aphid (R-60) (4)	
SARH	internal jammer	30mm (149)	AA-10 Alamo (CW) (R-27R) (6)	
Full Anti Air Load	Internal jammer	30mm (149)	AA-10 Alamo (CW) (R-27R) (4) AA-11 Archer (R-73) (2) AA-8 Aphid (R-60) (2)	

F-16 Falcon — chaff (60), flares (30)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only		M56A3		
Rear Aspect IR		M56A3	AIM-9P (8)	
All Aspect IR		M56A3	AIM-9M (8)	
Active Radar Missiles		M56A3	AIM-120A (8)	
Full Anti-Air Load		M56A3	AIM-7M (4) AIM-9M (4)	
SARH	jammer pod	M56A3	AIM-7F (2)	
Rockeye Load	jammer pod	M56A3		Mk 20 Rockeye II (6)
2 Mk 84s/2 AIM-9s	jammer pod	M56A3	AIM-9L (2)	Mk 84 AIR (2)
SEAD	jammer pod	M56A3	AIM-9L (2) CBU-58 (6)	AGM-88 HARM (2)

[1] All gun loadouts for this aircraft feature 500 rounds of 20mm ammunition.

F/A-18 Hornet — chaff (30), flares (30)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only	internal jammer	M56A3		
Rear Aspect IR	internal jammer	M56A3	AIM-9P (6)	
All Aspect IR	internal jammer	M56A3	AIM-9M (6)	
SARH	internal jammer	M56A3	AIM-7M (6)	
Active Radar Miss.	internal jammer	M56A3	AIM-120A (6)	
Full Anti-Air Load	internal jammer	M56A3	AIM-7M (4) AIM-9M (4)	
Mk 84 and AAM	internal jammer	M56A3	AIM-7F (2) AIM-9M (2)	Mk 84 (4)
Moderate AAM	internal jammer	M56A3	AIM-7F (4) AIM-9L (2)	
SEAD Load	internal jammer	M56A3	AIM-9L (2)	AGM-88 HARM (2) CBU-58A (2)

[1] All gun loadouts for this aircraft feature 570 rounds of 20mm ammunition.

SEPECAT Jaguar — chaff (60), flares (30)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only		30mm (150)		
Rear Aspect IR		30mm (150)	AIM-9P (6)	
All Aspect IR		30mm (150)	AIM-9M (6)	
French Bomb Strike	internal jammer	30mm (150)	Matra R 550 Magic (1)	Mk 82 (4)
French 2 CBU's	internal jammer	30mm (150)		CBU-58 (2)
British Bomb/AAM	internal jammer	30mm (150)	AIM-9L (2)	Mk 82 (4)
British Rockeye/AAM	internal jammer	30mm (150)		Mk 20 Rockeye II (4)
French A/G Missile	internal jammer	30mm (150)		AGM-65G (1)

AH-64 Apache — chaff (60)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only		30mm (1200)		
All Aspect IR		30mm (1200)	FIM-92 (4)	
AT/Full Load		30mm (1200)	FIM-92 (4)	AT-3 Anti-Armor Missile (8)

F-14 Tomcat — chaff (30), flares (30)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only		M56A3		
Rear Aspect IR		M56A3	AIM-9P (2)	
All Aspect IR		M56A3	AIM-9M (2)	
SARH		M56A3	AIM-7M (6)	
Active Radar Miss.		M56A3	AIM-54 Phoenix (6)	
Full Anti-Air Load		M56A3	AIM-54 Phoenix (4) AIM-7M (2) AIM-9M (2)	
Iranian F-14			AIM-54 Phoenix (2) AIM-7F (2) AIM-9L (2)	

[1] All gun loadouts for this aircraft feature 675 rounds of 20mm ammunition.

F-4G Phantom II — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Rear Aspect IR	internal jammer		AIM-9P (2)	
All Aspect IR	internal jammer		AIM-9M (2)	
SARH	internal jammer		AIM-7M (2)	
Active Radar Miss.	internal jammer		AIM-120A (2)	
Full Anti-Air Load	internal jammer		AIM-7M (2) AIM-9M (2)	
SEAD Load	internal jammer		AIM-7F (2)	AGM-88 HARM (2)
Heavy SEAD Load	internal jammer		AIM-7F (2)	AGM-88 HARM (4)
Shrike SEAD Load	internal jammer		AIM-7F (2)	AGM-45 Shrike (4)

MiG-21 Fishbed

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		23mm (200)		
Rear Aspect IR		23mm (200)	AA-2 Atoll (R-13) (4)	
All Aspect IR		23mm (200)	AA-8 Aphid (R-60) (4)	
SARH		23mm (200)	AA-10 Alamo (CW) (R-27R) (4)	
Full Anti-Air Load		23mm (200)	AA-10 Alamo (CW) (R-27R) (2) AA-8 Aphid (R-60) (2)	
Bomb Loaded		23mm (200)		FAB-250ShN (4)
Cluster Bomb Loaded		23mm(200)		RBK-500 (2)

Generic Defense (A-50, E-3, E-8, C-130, C-17, MH-53J, KC-135)

LOADOUT	Equipment	Gun	A/A	A/G
Cargo Pack	chaff (60), flares (60)			
Fighter Pack	chaff (60), flares (30)			

MiG-23 Flogger — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		23mm (200)		
Rear Aspect IR		23mm (200)	AA-2 Atoll (R-13) (4)	
All Aspect IR		23mm (200)	AA-8 Aphid (R-60) (4)	
SARH		23mm (200)	AA-10 Alamo (CW) (R-27R) (4)	
Full Anti-Air Load		23mm (200)	AA-10 Alamo (CW) (R-27R) (2) AA-8 Aphid (R-60) (4)	
Iraqi Bomb Loaded		23mm (200)	AA-2 Atoll (R-13) (2)	FAB-250ShN (6)
Iraqi Cluster Bomb Loaded		23mm (200)		RBK-500 (2)

MiG-25 Foxbat — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Rear Aspect IR			AA-2 Atoll (R-13) (6)	
All Aspect IR			AA-8 Aphid (R-60) (6)	
SARH			AA-10 Alamo (CW) (R-27R) (4)	
Full Anti-Air Load			AA-10 Alamo (CW) (R-27R) (2) AA-10 Alamo (IR) (R-27T) (2) AA-8 Aphid (R-60) (2)	

MiG-29 Fulcrum — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		30mm (150)		
Rear Aspect IR		30mm (150)	AA-2 Atoll (R-13) (6)	
All Aspect IR		30mm (150)	AA-10 Alamo (IR) (R-27T) (2) AA-8 Aphid (R-60) (4)	
SARH		30mm (150)	AA-10 Alamo (CW) (R-27R) (4)	
Full Anti-Air Load		30mm (150)	AA-10 Alamo (CW) (R-27R) (2) AA-8 Aphid (R-60) (4)	
A/G Missile Loaded		30mm (150)	AA-8 Aphid (R-60) (2)	AS-13 (2)
Bomb Loaded		30mm (150)	AA-8 Aphid (R-60) (2)	FAB-250ShN (8)
Cluster Bomb Loaded		30mm (150)		RBK-500 (4)

Mirage F1 — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		30mm (135)		
Rear Aspect IR		30mm (135)	Matra R 550 Magic (4)	
All Aspect IR		30mm (135)	AA-8 Aphid (R-60) (4)	
SARH		30mm (135)	Matra R 530 (4)	
Full Anti-Air Load		30mm (135)	Matra R 530 (2) Matra R 550 Magic (4)	
Coal. Strike/AAM	internal jammer	30mm (135)	Matra R 530 (2)	Mk 82 (2)
Iraq/Iran Bomb Load		30mm (135)	Matra R 550 Magic (2)	Mk 82 (4)
Iraq/Iran CBU Load		30mm (135)	Matra R 550 Magic (2)	RBK-500 (4)

Su-27 Flanker — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		30mm (149)		
Rear Aspect IR		30mm (149)	AA-2 Atoll (R-13) (10)	
All Aspect IR		30mm (149)	AA-10 Alamo (IR) (R-27T) (4) AA-11 Archer (2) AA-8 Aphid (R-60) (4)	
SARH		30mm (149)	AA-10 Alamo (CW) (R-27R) (6)	
Full Anti-Air Load		30mm (149)	AA-10 Alamo (CW) (R-27R) (4) AA-10 Alamo (IR) (R-27T) (2) AA-11 Archer (2) AA-8 Aphid (R-60) (2)	

Su-25 Frogfoot — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		30mm (250)		
Rear Aspect IR		30mm (250)	AA-2 Atoll (R-13) (8)	
All Aspect IR		30mm (250)	AA-8 Aphid (R-60) (8)	
SARH		30mm (250)	AA-10 Alamo (CW) (R-27R) (6)	
Full Anti-Air Load		30mm (250)	AA-10 Alamo (CW) (R-27R) (2) AA-10 Alamo (IR) (R-27T) (2) AA-8 Aphid (R-60) (4)	
Bomb Loaded		30mm (250)	AA-8 Aphid (R-60) (2)	Mk 82 (4)
A/G Missile Loaded		30mm (250)	AA-8 Aphid (R-60) (2)	AS-10 (4)
Cluster Bomb Loaded		30mm (250)	AA-8 Aphid (R-60) (2)	RBK-500

B-52 Stratofortress — chaff (30), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only	internal jammer	20mm tail cannon (1242)		
Full Mk 84s	internal jammer	20mm tail cannon (1242)		Mk 84 (20)

EA-6B Prowler — chaff (30), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
SEAD Loadout				AGM-88 HARM (2)

EF-111A Raven — chaff (30), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Normal	stand-off jammer pods			

Tu-22 Blinder — chaff (30), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		23mm tail (1000)		
Bomb Loaded		23mm tail (1000)		FAB-500ShN (4)

F-111 Aardvark — chaff (30), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Rear Aspect IR			AIM-9P (4)	
All Aspect IR			AIM-9M (2)	
Full Anti Air load			AIM-9M (2) AIM-9P (2)	
Air Shelter Buster	internal jammer			GBU-24 Paveway III (4)
Bad Weather	internal jammer			GBU-24 Paveway III (2) Mk 84 AIR (2)
Tank-Plinking	internal jammer			GBU-12 Paveway I (4)
GBU-15 Load	internal jammer			GBU-15 (V)-31 (2)
CBU Load	internal jammer			CBU-87 (4)

F-117 A Night Hawk

LOADOUT	Equipment	Gun	A/A	A/G
Bunker Buster				GBU-24A Paveway III (2)
GBU non-pen				GBU-24 Paveway III (2)

Su-22 Fitter — chaff (66), flares (66)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		30mm (160)		
Rear Aspect IR		30mm (160)	AA-2 Atoll (R-13) (2)	
All Aspect IR		30mm (160)	AA-8 Aphid (R-60) (2)	
Full Anti-Air Load		30mm (160)	AA-8 Aphid (R-60) (2)	
Bomb/Defensive Load		30mm (160)	AA-8 Aphid (R-60) (2)	FAB-250ShN (4)
Cluster/AAM Load		30mm (160)	AA-8 Aphid (R-60) (2)	RBK-500 (2)

F-5E Tiger II — chaff (30), flares (30)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only		M56A3		
Rear Aspect IR		M56A3	AA-2 Atoll (R-13) (4)	
All Aspect IR		M56A3	AIM-9L (4)	
Full Anti-Air Load		M56A3	AIM-9L (4)	
Coalition AAM-only Load		M56A3	AIM-9L (2)	
RSAF Load		M56A3	AIM-9L (2)	AS-10 (2)
RSAF Rockeye Load		M56A3	AIM-9L (2)	Mk 20 Rockeye II (2)

[1] All gun loadouts for this aircraft feature 560 rounds of 20mm ammunition.

Su-24 Fencer — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only	internal jammer	23mm (500)		
Bomb Loadout	internal jammer	23mm (500)		FAB-250ShN (6)

Mi-8 — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		23mm (400)		
AT Gunship		23mm (400)	SA-16 (2)	AT-3 Anti-Armor Missile (4)
All Aspect IR		23mm (400)	SA-16 (2)	

Iranian F-4E — chaff (60), flares (30)

LOADOUT	Equipment	Gun [1]	A/A	A/G
Guns Only		M56A3		
Rear Aspect IR		M56A3	AA-2 Atoll (R-13) (4)	
All Aspect IR		M56A3	AA-8 Aphid (R-60) (4)	
SARH		M56A3	AIM-7F (4)	
Full Anti-Air Load		M56A3	AIM-7F (4) AA-8 Aphid (R-60) (4)	
A/G Missile Loaded		M56A3	AIM-7F (2) AA-8 Aphid (R-60) (2)	AS-10 (2)
Bomb Load		M56A3	AIM-7F (2) AA-8 Aphid (R-60) (2)	Mk 82 AIR (4)
Cluster Bomb Loaded		.	M56A3 20mm (640) AA-2 Atoll (R-13) (2)	AIM-7F (2) RBK-500 (2)

[1] All gun loadouts for this aircraft feature 640 rounds of 20mm ammunition.

Mi-24 Hind — chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only		(12.7mm) (750)		
AT/Gunship		(12.7mm) (750)	SA-16 (4)	AT-3 Anti-Armor Missile (4)
All Aspect IR		(12.7mm) (750)	SA-16 (4)	

AC-130H Spectre Gunship — chaff (240), flares (120)

LOADOUT	Equipment	Gun	A/A	A/G
Full Load	internal jammer	AC-130H 105 Howitzer (100) AC-130H 20mm Vulcan (2 x 3000) AC-130H 40mm Bofors (256)		

MiG-35 Fulcrum —chaff (60), flares (30)

LOADOUT	Equipment	Gun	A/A	A/G
Guns Only	internal jammer	30mm (150)		
Rear Aspect IR	internal jammer	30mm (150)	AA-2 Atoll (R-131) (6)	
All Aspect IR	internal jammer	30mm (150)	AA-10 Alamo (IR) (R-27T) (2) AA-8 Aphid (R-60) (4)	
SARH	internal jammer	30mm (150)	AA-10 Alamo (CW) (R-27R) (2)	
Full Anti-Air Load	internal jammer	30mm (150)	AA-10 Alamo (CW) (R-27R) (4) AA-11 Archer (R-73) (2) AA-8 Aphid (R-60) (2)	
A/G Missile Loaded	internal jammer	30mm (150)	AA-8 Aphid (R-60) (2)	AS-13 (2)
Bomb Loaded	internal jammer	30mm (150)	AA-8 Aphid (R-60) (2)	FAB-250ShN (8)
Cluster Bomb	internal jammer	30mm (150)		RBK-500 (4)

Other Targets

This table is straightforward. Loadout and Radar list the weapons and radar the vehicle mounts. **Armor Type** affects the effect of various weapons. **Armor Points** and **Structure Points** describe how strong the vehicle is (see p. 240). Some listings here include generalizations, especially with regard to buildings. Not every building in the game fits exactly into one of the categories listed below. In those cases, use your best judgement for estimating armor and structure, based on the guidelines listed here.

Ships

	Loadout	Radar	Armor Type	Armor Points	Struct. Points
Destroyer	—	—	Normal	400	750
Frigate	—	—	Normal	300	500
Oil Tanker	—	—	Normal	75	1000
OSA-2 (SA)	OSA 2 30mm twin muzzle	Drum Tilt (OSA II Gun)	Normal	60	100
OSA-2 (SS)	SS-N-2A Styx	Square Tie (OSA Styx)	Normal	60	100
Perry FFG	Hawk	Drum Tilt (OSA II Gun)	Armored	300	500
Spruance DDG	AIM-7M Sparrow	Drum Tilt (OSA II Gun)	Armored	400	750

Tanks

	Loadout	Radar	Armor Type	Armor Points	Struct. Points
BMP-1	AA MG (12.7)	—	Armored	15	5
BMP-2	AA MG (12.7)	—	Armored	15	5
M-1	AA MG (12.7)	—	Armored	60	7
M-3	AA MG (12.7)	—	Armored	15	5
Roland	Roland	Roland	Armored	15	5
SA-13	SA-13	Snap Shot (SA-13)	Armored	15	5
SAM Command Track	—	—	Armored	15	5
T-62	AA MG (12.7)	—	Armored	30	6
T-72	AA MG (12.7)	—	Armored	60	7
ZSU-2-57	—	—	Armored	15	5
ZSU-4-23	ZSU-4-23	Gun Dish (ZSU-4-23)	Armored	15	5

Other Vehicles

	Loadout	Radar	Armor Type	Armor Points	Struct. Points
APC	—	—	Normal	15	5
BRDM-1	AA MG (12.7)	—	Soft	15	5
BRDM-2	AA MG (12.7)	—	Soft	15	5
BTR-50	AA MG (12.7)	—	Soft	15	5
BTR-60	AA MG (12.7)	—	Soft	15	5
Car	—	—	Soft	2	2
Fire Truck	—	—	Soft	3	3
Hummer	AA MG (12.7)	—	Soft	3	3
M-113	AA MG (12.7)	—	Armored	15	5
MTLB	AA MG (12.7)	—	Soft	15	5
SA-8	SA-8	Land Role (SA-8)	Normal	15	5
SA-8 Re-Supply Vehicle	—	—	Normal	15	5
SA-9	SA-9	—	Normal	15	5
SCUD TEL	SS-1 Scud 'B'	—	Soft	3	3
Tanker Truck 1-3	—	—	Soft	3	3
Truck 1, 2, 4	—	—	Soft	3	3
Truck 3	—	—	Soft	3	5
Winnebago	—	—	Soft	3	3

Other Objects

	Loadout	Radar	Armor Type	Armor Points	Struct. Points
Grounded aircraft, large	—	—	Normal	5	40
Grounded aircraft, small	—	—	Normal	5	20
Bridge (section)	—	—	Varies	600	600
Building, huge	—	—	Varies	100	2200
Building, large	—	—	Varies	75	1250
Building, medium	—	—	Varies	50	600
Building, small	—	—	Varies	30	125
Bunker, huge	—	—	Hardened	1000	2000
Bunker, large	—	—	Hardened	500	450
Bunker, small	—	—	Hardened	200	100
Camel	—	—	Soft	1	1
Infantry, entrenched	—	—	Varies	10	2
Oil tank, large	—	—	Varies	500	450
Oil tank, small	—	—	Varies	200	100

DAMAGE SYSTEM

Like most combat games, the focus of *F-15* is destruction. Every weapon can cause a certain amount of damage; every object can absorb a certain amount of damage before it is destroyed. The key to winning *F-15* is understanding the best ways to get your weapons and your targets close enough together to cause something explosive.

Part of that understanding is knowing how weapons and their targets interact in *F-15*, or at least knowing enough to be dangerous. The damage system in *F-15* is complicated, but the basics are fairly straightforward.

Each weapon has a damage value — how much damage it inflicts at its point of impact.

- Damage value is expressed in "damage points" — arbitrary units that don't mean anything unless you're comparing them to another weapon's damage points (to see which weapon inflicts the most damage) or comparing them to an object's "structure and armor points" (to see whether the weapon can destroy the object). Structure and armor points are described below.

Each weapon has a damage radius — over what distance this damage can extend.

- Even when an object is within a weapon's damage radius, the farther an object is from a weapon's point of impact, the less damage it takes from the weapon. Roughly speaking, doubling an object's distance from the point of impact doesn't just cut the damage in half — it cuts it down to a quarter.

Each object that can be destroyed has both "armor" and "structure." Armor protects structure; when structure is gone, the object is destroyed.

- Armor is expressed in "armor points."
- Structure is expressed in "structure points."
- Every time an object is hit, the object's armor absorbs damage points (unless the weapon is specifically designed to bypass the armor — it can absorb as many damage points as it has armor points.

- For example, a BMP-1 has 15 armor points. A weapon with 13 damage points can't hurt a BMP-1 — its armor will absorb all of the damage without its structure taking any damage. A weapon with 19 damage points will inflict 4 points of structural damage on a BMP-1 — the BMP-1's armor absorbs the first 15 points, but the remaining 4 points will cause structural damage. (Of course, this assumes that the BMP-1 is at the weapon's point of impact — if the weapon doesn't score a direct hit, the 19 points of damage will be reduced or even eliminated, depending on how far away the BMP-1 is, and what the weapon's damage radius is.)

Armor is not eliminated — each time a weapon strikes an object, that object's armor points can absorb the same number of damage points.

Structure can be eliminated — each time a weapon strikes an object, and the weapon inflicts more damage points than the object has armor points, the object's structure points are reduced. When an object's structure points have been eliminated, the object is destroyed.

Some weapons are specifically designed to destroy specific objects. For example, the **GBU-10G** is designed to penetrate several feet of concrete bunker before exploding. It tends to inflict much more damage on bunkers and other hardened objects than do other weapons. Durandal bombs are specifically designed to crater runways — few other weapons can do significant damage to a runway.

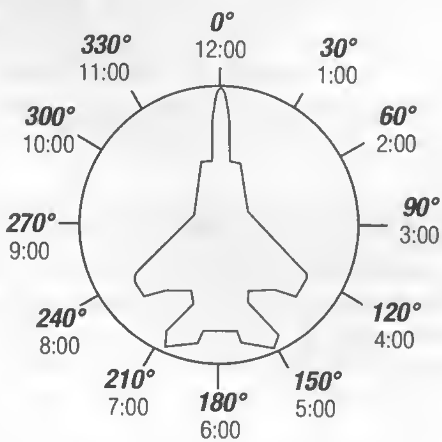
As an aircraft takes damage, its capabilities are reduced. All aircraft can take specific damage to its engines, radar, hydraulics, fuel tanks, guns and other weapons. It isn't necessary to completely destroy an aircraft to eliminate it. For example, if an aircraft's engines are destroyed, it won't stay in the air much longer, even if it has taken no other damage.

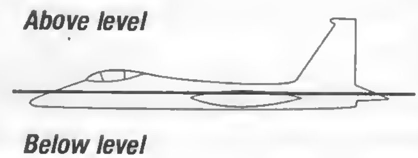
F-15E Damage Locations

Damage to a player's F-15 is even more specific — 32 locations can be damaged. In essence, each of the 32 locations is a separate "object," with its own armor and structure points. (In general, each F-15E location has 5 armor points and 5 structure points.) However, these locations are interrelated — if one is destroyed, remaining damage is likely to spill over to nearby locations.

The point at which a weapon strikes a player's F-15E, determines what might be damaged. The following diagrams describe what can be hit, based on where a weapon strikes. Note that many of the diagrams overlap — a weapon that strikes within an overlapped area can strike a location from any of the combined areas.

For example, a missile that strikes from directly behind the F-15E (i.e., at 180°, or 6:00) can hit either engine, since the right engine is vulnerable between 90° and 210° (3:00 to 7:00) and the left engine is vulnerable between 150° and 270° (5:00 to 9:00). If the missile is also approaching from below at a very sharp angle (steeper than 60°), the emergency hydraulics are vulnerable, as well



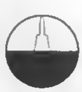


20° — 90° (12:40 to 3:00)

Gun	Gun is inoperable.

20° — 90° or 270° — 340° (12:40 to 3:00 or 9:00 to 11:20)

Fuel Tanks	A fuel tank has been punctured, a fuel pump damaged or a fuel line severed. Your fuel capacity is significantly reduced.



90° — 270° (3:00 — 9:00), pitch greater than 60° (i.e., extreme underbody shot)

Emergency Hydraulics	You have no hydraulic control at all.

270° — 90° (9:00 to 3:00)

Radar	Radar inoperable.

270° — 90° (9:00 to 3:00), level or above

Oxygen	Oxygen is low. You will black out if you.do not drop below 10,000ft.
HUD	You've lost your HUD display.

270° — 90° (9:00 to 3:00), level or below

Flight Controls	The Control Augmentation System (CAS) is inoperable.
PACS	You can't release weapons, except by jettisoning them.
Central Computer	You've lost all displays (HUD, MPDs, UFC, etc.).
Air Data Computer	You've lost pitch ratio, autopilot attitude hold and all HUD symbology except heading scale.
Autopilot	Autopilot system inoperable.
TEWS	TEWS is inoperable (but you can still drop chaff and flares manually).
Target IR	Target IR camera is inoperable.
NAV FLIR	NAV-FLIR system is inoperable.

150° — 270° (5:00 — 9:00)

Left Bleed Air	Bleed air leak in the left engine. A fire will start if you don't shut the engine down.
Left Engine Control	Left engine control inoperative. You cannot afterburn, and your maximum engine thrust is reduced.
Left Oil Pressure	Left oil pressure is low. A fire will start if you don't shut the engine down.
Left Afterburner	Left afterburner is inoperative.
Left Fuel Pump	Left fuel pump is failing or has failed. If both fail, descend below 30,000ft and do not afterburn, or you risk flaming out your engines.
Left Generator	Left generator is failing or has failed. If both generators fail, you've lost most displays and control of your speed brakes.
Left Main Hydraulic	A primary hydraulic circuit is inoperable. When both hydraulic lights are lit, you have no radar or speed brake control, and reduced flight control.
Left Engine	Left engine is inoperable.

90° — 210° (3:00 — 7:00)

Right Bleed Air	Bleed air leak in the left engine. A fire will start if you don't shut the engine down.
Right Engine Control	Right engine control inoperative. You cannot afterburn, and your maximum engine thrust is reduced.
Right Oil Pressure	Right oil pressure is low. A fire will start if you don't shut the engine down.
Right Afterburner	Right afterburner is inoperative.
Right Fuel Pump	Right fuel pump is failing or has failed. If both fail, descend below 30,000ft and do not afterburn, or you risk flaming out your engines.
Right Generator	Right generator failing/failed.If both generators fail, you've lost most displays and control of your speed brakes.
Right Main Hydraulic	A primary hydraulic circuit is inoperable. When both hydraulic lights are lit, you have no radar or speed brake control, and reduced flight control.
Right Engine	Right engine is inoperable.

SYRIA
Dahūk
Tall Huqnah
dam
Sinjār
Aqrah
Mosul
NĪNAWĀ
ARBIL
Irbil
Karkūk
AT
Bayjī
Tikrīt
SALĀH AD DĪN
Sāmarrā'
Al Qā'im
Akāshāt
AL ANBĀR
Hadīthah
Ar Rutbah
dam
Ar Ramādī
Al Habbānīyah
Al Fallūjah
Khānaqīn
DIYĀLĀ
Ba'qūbah
Baghdad
BAGHDAD
Mandalī
An Nukhayb
Karbalā'
KARBALĀ'
Al Hindīyah
BĀBIL
Al Hillah
Al Kūt
An Najaf
Ad Dīwānīyah
AL QĀDISĪYAH
AN NAJAF
Euphrates
As Samāwah
Iraq
onal boundary
muḥāfaẓah) boundary
pital
ḥāfaẓah) capital
As Salmān
AL MUTHANNĀ
Rafḩā'
Al Buşayyah
SAUDI

F-15E STRIKE EAGLE

HISTORY

Note: *Specifications and a 1996-97 Jane's entry for the F-15E Strike Eagle appear on pp. 262-295.*

Introduction

Since its maiden flight in 1972, the F-15 Eagle fighter has undergone several evolutions, first as a one-seater, then a two-seater, then back again. It is the most versatile fighter in existence, capable of air-to-air combat at 30,000 feet, nap-of-the-earth approaches at a mere 100 feet of altitude and blistering air-to-ground attacks.

The F-15E Strike Eagle has matured into a precision air superiority fighter that remains unsurpassed in its day and night attack capabilities. It has affectionately become known to its crews as the Mud Hen, the Beagle, the Strike Pig, the Wart Eagle, and sometimes, simply, the E.

FX-15 Program

Before the F-15 was developed, the premier U.S. fighter was the McDonnell F-4 Phantom — a multi-role aircraft from the late 1950s that had achieved less-than-impressive combat kill ratios during the Vietnam War. The Phantom had been designed for BVR (beyond visual range) combat and not close-range dogfighting. With the advent of guided weaponry, strategists had assumed that combat would rarely, if ever, take place close enough for aircraft to spot one another visually. However, confrontations and losses in Vietnam challenged this doctrine. Realizing that long-range capabilities alone did not guarantee fighter success, the USAF issued a request for proposals for a close-support, dual-role fighter in 1966. None of the resulting designs were considered adequate, however, and the project stalled.

In 1967, the Soviet Union started production of its Mikoyan MiG-25 Foxbat and unveiled several other advanced aircraft. With the Cold War in full swing, the Air Force grew worried that its fighters were lagging behind and that the U.S. could conceivably fall behind technologically. The USAF issued a second request for

proposals, this time specifying a lighter, fixed-wing fighter. After numerous concept plans were submitted by many key players in the industry, McDonnell Douglas was given the go-ahead to proceed with full-scale designs for the project, now dubbed Fighter-Experimental 15 (FX-15).

The contract engineers detailed plans for a single-seat, swept-wing fighter with advanced avionics and an admirable supply of air-intercept missiles. Air-to-ground ordnance was also written into the design, although air-to-air combat was to remain the aircraft's primary function. The first F-15 prototype flew in July 1972, and delivery of 107 aircraft was scheduled for November 1974.

Unlike most fighter development programs, the "X" version of the F-15 was never built — to conserve cost, the aircraft went straight from prototype to production. Much of the design testing involved half-size, radio-control models that were dropped from high altitudes. Later, actual prototype evaluations involved ten separate aircraft, each tasked with a different aspect of aircraft performance.

From A-Model to D-Model

The first operational versions of the F-15A were delivered, as scheduled, in November 1974 to the 555th Tactical Fighter Training Squadron of the 58th Tactical Training Wing at Luke AFB, Arizona. Soon after, a two-seater training version (the F-15B) was developed. Deliveries to the first combat-ready wing (1st Tactical Fighter Wing at Langley Air Force Base in Virginia) did not commence until January 1976. All of these early aircraft had maintenance and engine performance problems, which drove revisions to the original design.

In 1979, the F-15C and D were developed. Like its A-model predecessor, the C-model was a single-seat aircraft. The D-model was like it in every way, except that it was a two-seater. Both featured FAST (Fuel and Sensor Tactical) packs that could house fuel and support an array of camera, sensor and jamming equipment or weapons on mounting points. Later known as CFTs (Conformal Fuel Tanks), they extended the range of the aircraft from approximately 2300 to nearly 3500 nautical miles and expanded its combat capabilities considerably.

Both the F15C and F15D versions also had additional internal fuel tanks and improved electronics. An upgraded Hughes AN/APG-63(v)1 radar system was added, and Pratt & Whitney F100-PW-220 turbofan engines were incorporated for the first time.

Development of F-15E

Up to this point, all versions of the F-15 Eagle had been strictly air-to-air fighters. Despite McDonnell Douglas' insistence that the F-15 showed extreme air-to-ground potential, the USAF (and other important parties handing out development dollars) still believed that the F-111 could accomplish all air-to-ground missions. But McDonnell Douglas remained convinced that the F-15 could fulfill its originally conceived purpose as a multi-role fighter. The company privately teamed with Hughes Aircraft in the late 1970s, and by the time the 1980 Farnsborough air show commenced, an existing F-15B had been converted into a multi-role fighter.

The two-seater prototype, known as the Strike Eagle, boasted several modifications that would ensure its later success. First, the back seat was configured with two monochrome and two color displays for the Weapons System Officer (WSO — or "wizzo" for short). Secondly, the updated AN/APG-63 radar system added synthetic aperture radar capabilities (SAR). SAR was especially important because it allowed the WSO to capture a static, high-resolution image of the target area and zoom in as necessary to identify targets and terrain features from far away. Finally, the Strike Eagle was outfitted with a centerline gun pod and Pave Track laser designator pod. This both alleviated the problem of engaging aircraft at close range and allowed the fighter to lase its own ground targets instead of having to rely on a second aircraft or ground unit as a target-spotter.

Despite these added capabilities, the Strike Eagle did not attract any buyers at its debut air show. The USAF had already started soliciting concept designs for an Enhanced Tactical Fighter to replace its aging fleet of F-111s, but it was looking for a strike fighter that could operate as a lone entity, without the assistance of escorts or AWACS. The F-15 Strike Eagle prototype had not been developed with this is mind, and it looked like the development effort might have been in vain.

In the early 1980s, however, with R&D costs escalating and the worldwide race for technology heating up, suggestions for an alternative solution surfaced. Thinking it might be cheaper to convert an existing aircraft than to design an entirely new one, the USAF scheduled a fly-off between the F-15 and the still-in-development F-16XL. One of the five test aircraft was the original Strike Eagle prototype. McDonnell Douglas' collaborative, independent design effort paid off in February 1984, when the F-15 was announced the winner of the Dual-Role Fighter competition. Full-scale development began later that year, and in late 1986, the F-15E Strike Eagle joined the official production list.

Auxiliary Programs

An F-15A was modified in the winter months of 1974 and 1975 in an effort to break existing speed records. This specially adapted aircraft had no paint and housed only the systems it needed to climb and land safely. These weight-reduction efforts worked, dropping the aircraft's weight by an amazing 1800 pounds.

The program was code-named *Operation Streak Eagle*, and by 1 February 1975, the aircraft was able to climb to 30,000 meters in under three-and-a-half minutes. The trials were held at Grand Forks Air Force Base in North Dakota, one of the coldest spots available, in order to maximize the aircraft's performance. (Colder air is less dense, and therefore is easier to fly through.) At the time, this shattered eight existing time-to-climb speed records held by the MiG-25 Foxbat and F-4B Phantom. These records stood until the development of the Su-27 Interceptor in the late 1970s.

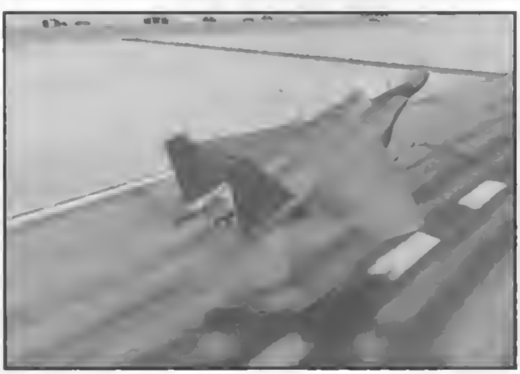
About this same time, another F-15A was adapted under an anti-satellite (ASAT) program. The goal of the operation was to develop an aircraft that could climb high enough to deliver a weapon capable of knocking out an enemy military satellite. The weapon carried by this Eagle was the Vought ASM-135A, a two-stage rocket with infrared tracking capabilities. Unlike most conventional weapons, the ASM-135A had no warhead — mere impact would be more than enough to render a delicate satellite useless.

For the first actual launch, the adapted F-15A climbed to 80,000 feet, where it released the ASM-135A into empty space. Several other launches were made, with the weapon directed toward stellar infrared sources. The only space vehicle to ever be destroyed by the anti-satellite F-15A was the Solwind P78-1 in September 1985. (The satellite had previously been collecting and reporting spectroscopy data.) Following these tests, plans were drawn up to modify 20 existing F-15As for this mission type. However, Congress insisted that testing be terminated in accord with a U.S.-Soviet treaty to not produce anti-satellite weaponry.

The Eagle had another brush with space-related testing in 1976, when an existing F-15A was used to measure the durability of thermal tiles for NASA's shuttle program. A second F-15A tested an automatically correcting flight control system under the HIDEC (Highly Integrated Electronic Control) program.

F-15s have been involved in testing many other new systems, some of which are currently in place on the F-15E Strike Eagle. These systems include the Global Positioning Satellite, as well as various jamming and countermeasure packages. An F-15B was also the test vehicle for McDonnell Douglas' Integrated Flight Fire Control (Firefly III) program in 1981, which augmented the pilot's controls during different weapon delivery modes. The program never reached production, since the development of the LANTIRN system fulfilled its purpose.

Finally, under *Operation Agile Eagle*, an F-15B was modified in an attempt to develop an STOL (short takeoff and landing) demonstrator aircraft. The integrated flight and propulsion control system used for this purpose was designed to take over several routine piloting duties. Physically, the aircraft body was reinforced, and canards (small wing surfaces that can be angled during flight) were added. The intention was to create an aircraft that could land on short, damaged runways in severe weather or wind conditions without any assistance from ground control. The resulting NF-15B flew over 40 test flights in 1988. For the second phase of testing, small thrust-vectoring nozzles were added. The pilot could angle the engine thrust up or down by 20°, as well as reverse the direction of thrust. The modified F-15 could land on less than 2000 feet of runway, just over one-third the distance required by a normal F-15. This test program was completed in August 1991, but no existing F-15s have been altered as a result.

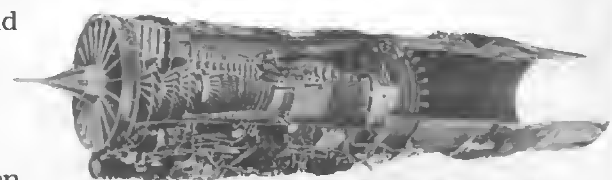


COMPONENTS

Engines

Early Eagles had a reputation of temperamental engine performance, mainly because the newly developed Pratt & Whitney F100-PW-100 engine had not seen much operational time and still had a few unforeseen problems. First, abrupt changes in throttle settings in the highly maneuverable F-15 caused unexpected wear on the engines. But more importantly, the engines commonly experienced stagnation stalls — at high angles of attack and high altitudes, the airflow into the combustion chamber would be reduced, and power would dwindle or cease. Solving this problem became paramount.

By 1981, most Dash 100 engines had been replaced with Dash 220s. These improved twin turbofan afterburner engines featured nozzles that could be angled to ensure that the air intakes faced the airflow head-on at different angles of attack.



Pratt & Whitney FW-100-220

Recently built F-15Es have been fitted with the Dash 229 engine, which takes advantage of the Digital Engine Control Unit. This modular device lets the pilot power up from zero to full throttle in just under four seconds. The Dash 229 requires only half the maintenance of its predecessors and boasts a 6% savings in fuel. To reduce the risk of an engine fire rendering both Dash 229 engines useless, fire suppression bottles are installed between the engine bay firewalls. In the event of a fire, fire-retardant foam is sprayed through a series of nozzles, either into the engine itself or inside the compartment separating the two engines.

With its conformal fuel tanks (CFTs), the F-15E requires less internal fuel capacity than its earlier versions. The aircraft has eight separate internal tanks that can carry a combined load of nearly 1800 gallons of fuel. If an external CFT is mounted under each wing base, the aircraft can carry over 1000 extra gallons of fuel and an array of weapons. (See **Weapons**, p. 256, for more information about CFTs.)

Structure

When the F-15 fighter series was redesigned to fulfill air-to-ground mission roles, the airframe itself returned to the drawing board. Since Air-to-ground weaponry is significantly larger and heavier than air-to-air missiles, the aircraft had to be redesigned to handle higher G-loads and takeoff weights. Sixty percent of the original design was changed, and, the rear fuselage and wing bases were redesigned using lightweight titanium instead of standard alloys. About a quarter of the aircraft is now composed of titanium.

The new airframe on the F-15E Strike Eagle provides other advantages. Durability has been extended to 16,000 flight hours, nearly a 100% increase. Extra space has intentionally been built into the structure to allow ground crews to expand avionics systems in the future. Finally, the maximum weight at which the aircraft can take off has increased to 81,000 pounds — more than enough to accommodate a full weapons and fuel load.

Avionics

Note: *Jane's entries for the F-15E's avionics systems appear on* *pp. 272-275.*

Although the physical improvements to the F-15E increased its ability to fulfill its mission role, the heart of the Strike Eagle's advantage is its high-end avionics systems. The F-15E can fly at night and under adverse weather conditions, attacking from both high and low approaches. Such versatility — the result of thousands of man-hours of research and development — gives the F-15E an edge over its Russian counterparts.

AN/APG-70 Radar

The F-15E's ability to strike quickly and without warning is primarily due to the advanced Hughes AN/APG-70 I-band radar system. The radar's signal processor can process nearly 30 million operations per second, five times as fast as the old F-15-series radar, the AN/APG-63.

The AN/APG-70 emits radar waves which travel outward in a cone away from the aircraft. If a wave strikes something, it reflects back to the system. By measuring the time it takes for this wave to return, the radar can determine the distance to the object it struck.

The AN/APG-70 radar is also capable of analyzing the Doppler shift of radar returns. *Doppler shift* is the apparent change in the frequency of a wave that occurs as the relative velocities of the observer and the source change. An example of this effect can be observed in sound waves — as the ambulance moves toward you, the sound of its siren grows higher-pitched. As it passes you and moves away, the siren grows lower-pitched. Similarly, the AN/APG-70 can measure the change in frequency of radar returns to determine Doppler shift effect.

In air-to-air mode, the AN/APG-70 is capable of alternating the *pulse repetition frequencies*, or PRFs, of the radar waves it sends out. It can send out high-PRF waves, which return more accurate information about long-range, high-closure contacts — objects that return a strong Doppler shift. It can also send out medium-PRF waves, which provide a more accurate picture of low-closure contacts — objects that return only a weak Doppler shift. Better still, the AN/APG-70 can alternate between high and medium PRFs as it makes its scan, thus collecting the most accurate information about all types of targets.

In air-to-ground mode, the radar can analyze Doppler shift to look for moving ground targets. Areas where Doppler shift occurs indicate areas where moving ground targets may be located, and these areas are marked on the radar screen.

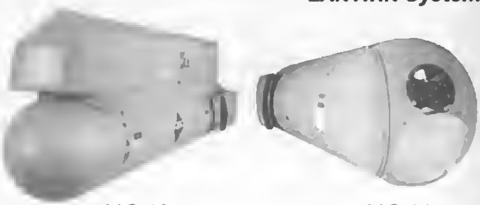
Also in air-to-ground mode, the radar can create *synthetic aperture radar* (SAR) images of target areas to the left or right of the aircraft's nose. These high resolution maps (HRMs or "patch maps") are static, photo-realistic images that can be stored and displayed in place of the regular air-to-ground radar display. From over 100 miles away, the WSO can use HRMs to help identify target areas and ground complexes. At closer ranges, available map resolutions are higher, and individual targets can be seen.

While the WSO is evaluating these HRMs, the radar is frozen (i.e., not emitting). Since he can store and retrieve several of these maps, he can make a target designation without having to switch the radar on. In fact, the ability to freeze or "sniff" the radar in both air-to-air and air-to-ground modes is one of the distinct advantages of the AN/AGP-70. Since the aircraft doesn't continuously broadcast radar signals, enemy radars find it harder to detect and pinpoint a low-flying, inbound Strike Eagle.

LANTIRN System

One of the easier acronyms to master, the LANTIRN (Low-Altitude Navigation and Targeting Infra-Red for Night) system is the F-15E's best weapon in some respects. It allows the aircraft to do something few other modern fighters can do — penetrate hostile airspace under the cover of complete darkness and acquire and designate its own targets. The LANTIRN system was developed in the late 1980s, just prior to the Gulf War, and the F-15E was selected as its first operational carrier. However, production was slow and problematic, so few F-15Es were equipped with the pods until late in the war.

LANTIRN System



The LANTIRN consists of separate navigational and targeting pods that are mounted under the aircraft. The smallest one, the AAQ-13 navigation pod, contains a terrain-following radar (TFR) and a forward-looking infrared (FLIR) camera. The TFR analyzes radar waves reflected from of the ground in front of the aircraft, to determine the dimensions of the terrain being overflown. This gives the pilot the ability to fly on autopilot at altitudes as low as 200 feet above ground level. The FLIR camera superimposes monochrome, infrared video over the HUD, giving the pilot a clear image of what's ahead at night or under bad weather conditions.

The other half of the LANTIRN system is the AAQ-14 targeting pod, which contains a second IR camera used for targeting and a laser designator. The AAQ-14 targeting IR camera can display infrared video images of air and ground targets. It can be zoomed in to three different levels. The laser designator that is aligned in the same direction as the IR camera. The WSO can use the laser to calculate the range to a target before dropping dumb bombs, or to designate a target for a laser-guided weapon. Both the FLIR and laser components can swivel in a half-sphere below the aircraft in order to keep a target in view.

Tactical Electronic Warfare System (TEWS)

The TEWS is a conglomeration of four separate component systems, which controls threat detection and identification and both physical and electronic countermeasures.

The system uses five mounted antennae to gather and feed information to several processors. The radar warning receiver (AN/ALR-56C) initially detects radar emissions. Emissions data are then sorted and identified, and the threats then displayed on an MPD page available to both pilot and WSO in the cockpit. The position of the threat, signal strength and type of radar are all indicated on a top-down display of the aircraft using coded symbols.

By analyzing emissions patterns, the TEWS can also determine whether an enemy radar is specifically tracking the aircraft. It can also detect when a threat radar is feeding radar information to a missile it is launching. Based on this data, the TEWS assigns each threat a priority and alerts the pilot and WSO to what threats are doing with visual and audio warnings.

The electronic warfare warning set (AN/ALQ-128) cues the onboard jammer (AN/ALQ-135C Internal Countermeasures Set) as to the type, frequency and pattern of threat emissions. The AN/ALQ-135C is then capable of fighting both pulse and continuous-wave sources, as well as adapting to intentional variations in the enemy's signal. The jamming signal can be activated and deactivated either manually or automatically.

The AN/ALE-40 dispenses physical countermeasures — chaff and flares. The TEWS can be set to automatically control the release of chaff — determining when to release cartridges, how many to release and how far apart to release them in order to best combat the specific threat being countered. Flare release must always be manually controlled, however, as the TEWS cannot detect IR-guided threats.

The TEWS is especially helpful when the target area is dense with threats and inbound missiles. The system requires little to no crew intervention, although either the pilot or WSO can manually control some of the TEWS functions.

Weapons

***Note:** Specifications and Jane's descriptions for the F-15E Strike Eagle's weapons systems appear on pp. 276-295.*

As an adept dual-role fighter, the F-15E is able to carry many different weapon configurations, depending on the mission objectives. Three separate hardpoint rails exist — one pylon beneath each wing, and along the centerline of the aircraft's belly. All are capable of carrying either bombs or air-to-air missiles, giving the F-15E an astounding array of armament possibilities.

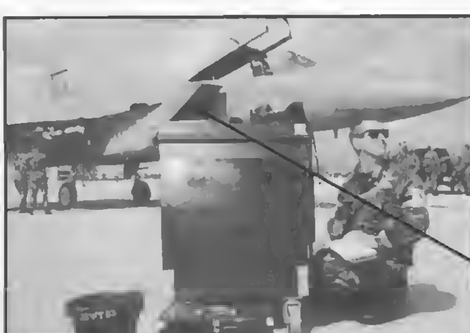
Conformal Fuel Tanks

The addition of the conformal fuel tank (CFT) augments the aircraft's weapon and fuel loads considerably without sacrificing any normal hardpoints. CFTs can be mounted just between the wing pylon and wing base on either side of the aircraft. The tanks blend into the natural shape of the aircraft, visually appearing as an extension of the aircraft's body. Three stub pylons protrude from the lower, outside edge of each CFT and are restricted to carrying a single small bomb each, usually an Mk 82 or Mk-20 Rockeye. A continuous rack underneath the center of each tank gives the F-15E the flexibility to carry two large bombs, three small bombs or ejector racks for two extra air-to-air missiles. Many times, one CFT will have a duo of AIM-7M Sparrows on the continuous rack, while the other CFT carries bombs.

To see which weapon configurations can be loaded on hardpoints and conformal fuel tanks (CFTs), see the **Allowable Stations/Weapons** on p. 212.

F-15 with Conformal Fuel Tanks

F-15 without Conformal Fuel Tanks



Air-to-Ground Weapons

The F-15E can carry Mk 20 Rockeyes, Mk 82 (500lb) and Mk 84 (2000lb) bombs — all "dumb" weapons without internal guidance systems. Their range and accuracy is highly dependent on release conditions, The faster your airspeed and the higher your altitude, the further the bombs will travel when released during level flight.

Some unguided weapons fall into the Cluster Bomb Unit (CBU) family. These weapons explode prior to contact, dispersing smaller bomblets over a widespread area. Depending on the size and strength of these bomblets' warhead, these weapons can be used against hard or soft targets. Some bombs in the CBU family have incendiary capabilities.

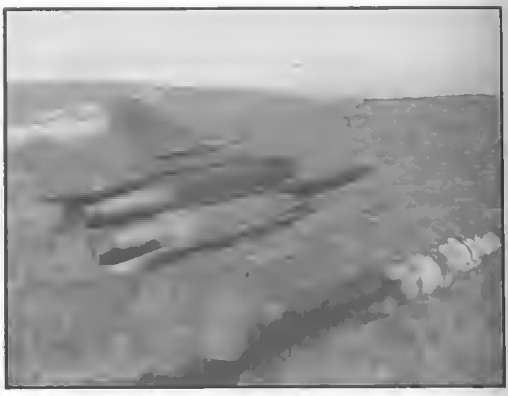
Guided Bomb Units (GBUs) consist of modified conventional Mk weapons fitted with some type of guidance system. In the case of the GBU-10, -12, -24 and -28s Paveways, guidance is by semi-active laser. After release, a laser error detector in the body of the weapon measures the angle between the bomb's flight path and a direct line from the bomb to its target. The latter is computed from the position of the laser beam played over the target by a laser designator mounted in the LANTIRN AAQ-14 targeting pod. Canard control fins on the bomb are capable of make small steering corrections. Laser-guided bombs can be accurately dropped from high altitudes. During the Gulf War, over three-quarters of these laser-guided bombs struck their targets as planned.

The GBU-15 is a Mk 84 or BLU-109 bomb fitted with a TV or imaging IR seeker head. Video imagery can be displayed in a cockpit MPD and used to guide the weapon before launch. If a datalink pod is mounted on the launching aircraft, steering signals can also be sent to the weapon after launch.

AGM-65 Maverick is the only air-to-ground missile carried by the Strike Eagle. Designed for close- to medium-range standoff attacks, heat-seeking AGM-65s are highly effective on night strikes and against hardened targets. And as fire-and-forget missiles, they allow a pilot to break from the attack as soon as they leave the rail.

Finally, the F-15E has been cleared to carry a total of five B61 nuclear weapons. It is also a likely candidate for advanced weapons currently in development, including those guided by inertial navigation and global positioning systems.

Air-to-Air Weapons



If air-to-air encounters are anticipated, the F-15E normally carries a loadout comprising AIM-7 Sparrows, AIM-9 Sidewinders, and/or AIM-120 AMRAAMs. Up to eight air-to-air missiles can be loaded, but fewer are often mounted in order to leave room for more air-to-ground ordnance.

The AIM-9M Sidewinder is an all-aspect, infrared missile. This means it doesn't have to approach an enemy aircraft from the rear to be able to home in on it. The Sidewinder is generally considered a short-range weapon, most effective within three nautical miles. It is mounted on the standard rail launcher on the wing pylon.

The AIM-7 is a semi-active radar-homing weapon that requires continuous target designation from the firing aircraft. It is a medium-range, all-weather, all-aspect weapon. As of late, it has been replaced by the AIM-120 AMRAAM. The active radar-guided AAMRAAM has a greater range and increased reliability. Unlike the AIM-7, it has an active radar terminal seeker, which can gain its own lock on a target in mid-course using target position and movement information supplied by the launching aircraft.

The F-15E is also equipped with a 20mm M61A1 rotary cannon mounted on the right side of the aircraft, just forward of the wing. Although most combat takes place beyond gun range, most guided missiles cannot activate their sensor systems until they've travelled several thousand feet. For this reason, guns remain an integral weapon in air-to-air combat.

ROLE OF THE STRIKE EAGLE

The F-15E is by no means an aircraft to be taken lightly. It can break the sound barrier and skim along the earth on autopilot at altitudes as low as 200 feet. With a fully self-sufficient suite of avionics and guided weapons, a pair of Strike Eagles can act alone, delivering a precision attack by day or night. Their first mission is likely to be a deep strike — stealing far behind enemy lines under the cover of darkness and unloading ordnance on a tactical ground target. It is this type of mission that gives the Strike Eagle its reputation as an able ground-pounder.

Today's F-15E can accomplish nearly any type of ground strike mission. In almost all cases, the pilot makes a low, nap-of-the-earth (NOE) entry into the area to avoid radar, climbs just prior to entering the target zone, releases weapons, then drops back down to NOE for the trip home. By using the LANTIRN navigation and targeting pods, the Strike Eagle can in most cases follow this lo-hi-lo pattern and safely reach the target area. If any bogies cross the F-15's path, the TEWS or AN/APG-70 in air-to-air mode provides early detection. If the need arises, the Strike Eagle can climb to meet the attacker and aptly defend itself.

The early F-15s (A, B and C/D variants) were specifically designed as air-to-air interdiction fighters. Every aspect of these models was oriented toward long-range air combat against the Russian MiG family and other modern fighters. The F-15E Strike Eagle, by contrast, currently occupies the dual-role fighter gap identified by the Air Force in the early 1980s. Its primary duty is to perform air-to-ground strikes against valuable targets deep inside enemy territory. In an auxiliary capacity, the F-15E can handle almost any air foe it encounters. This makes a flight of Strike Eagles nearly self-sufficient — F-15Es rarely need an escort to accomplish its mission, and can arrive, strike and exit under the most adverse flying conditions.

Combat Experience

In the Gulf War, F-15Es operated from Al Kharj airbase in Saudi Arabia, fondly coined "Al's Garage" by the air and ground crews that resided there throughout the war. For five months, pilots and WSOs trained there, preparing themselves for the strike mission against Iraq that could happen any day. When that day did come, 17 January 1991, nineteen Strike Eagles and their crews were ready. The first hits were delivered by F-15s approaching at altitudes of only 500 feet, attempting to slide in under enemy radar cover. Their attacks were coordinated with those of the AH-64D Longbow Apache, which had been tasked with taking out many of Iraq's communication sites and early warning radar systems.

Many of the Strike Eagle targets were mobile Scud launchers no larger than fuel trucks. "Scud-hunting" missions became especially important later in the war, after Iraq began firing these large missiles at Israel. F-15Es hit other targets vital to Iraq's military infrastructure as well — communications buildings, strategic bridges and airfields. Once those were dispensed with, the Strike Eagle became an anti-tank vehicle, scouring the desert at night for hot objects. Other missions assigned to Strike Eagles in Iraq were attacks on Najaf, Tallil and Samawah — all important Iraqi air defense targets — and air support for beleaguered units on the ground. SEAD (suppression of enemy air defense) missions were critical as well, paving the way for heavy air strikes. All in all, the F-15E boasted an impressive 95.5% mission capable ratel ratio in the Gulf.

A pair of Strike Eagles flying past the pyramids of Giza.

The largest problem faced by Strike Eagles in the Gulf War was the lack of LANTIRN pods. Pilots spent many grueling hours in the air, circling around a refueling tanker or waiting for target feeds from E-8A J-STARS. Toward the end of the conflict, most F-15Es were outfitted with their own pods and were able to operate independently. (More about the F-15's role in the Gulf War can be found in the game's *Expert Flight Manual* p. A.1.)

The Persian Gulf was the Strike Eagle's debut appearance. However, it saw combat again in 1994, when F-15Es were tasked with supporting NATO's "No Fly Zones" established over Bosnia. Many of the missions were merely patrols, but on one occasion, almost 40 Strike Eagles were sent to attack an airfield near Bihac. Most F-15s in Bosnia during that period flew night-time patrols, carrying air-to-air missiles and laser-guided bombs in case trouble arose. The main purpose for their presence was to maintain no-fly zones through UN-protected areas. Though most flights were uneventful air patrols or relief efforts, occasional bouts with enemy aircraft were documented.

JANE'S SPECIFICATIONS

The descriptions and specifications in this section were taken from the **Aircraft — Military Aircraft — Fixed Wing** section of the 1996-1997 edition of *Jane's All The World's Aircraft.* Additional specifications for aircraft and ground objects are available in the game. To view them, select **REFERENCE** from the main menu screen.

Descriptions and/or statistics have been abridged due to space constraints. British spellings have been preserved. If appropriate, the following statistical information is provided for each entry:

Ailerons. Total surface area of aircraft's ailerons (in square meters)

Body Diameter. For missiles, the widest point (in millimeters).

Calibre. For artillery and guns, interior diameter of the barrel (in millimeters).

Filling. For bombs, the inner explosive material.

Fins. Total surface area of aircraft's fins (in meters squared.)

Flaps. Total surface area of aircraft's flaps (in meters squared.)

Fuze. For weapons, means by which weapon is detonated.

Guidance. For weapons, type of system that guides weapon to target after release.

Height overall. For aircraft, distance from ground to highest point on tailplane or fuselage (in meters).

Launch weight. For weapons, the weight of the weapon including fuel (in kilograms).

Length. For weapons, measured from tip to base or tail (in meters).

Length overall. For aircraft, measured from nose to tail at longest point on fuselage (in meters).

Lug Spacing. For weapons, the distance between mounting lugs.

Max combat radius. How far (in nautical miles) the aircraft can operate while fully loaded and still retain enough fuel to return to base.

Max weapon load. Maximum weight of ordnance (in kilograms) that can be loaded onto hardpoints if aircraft is to safely take off or land.

Max fuel weight. For aircraft, weight of fuel (in kilograms) that can be held in different fuel tank configurations.

Max level speed at height. Maximum speed (in Mach numbers) achieved by the aircraft's power plant alone (i.e., not accelerated by diving, etc).

Max normal operating speed. Normal speed beyond which the aircraft is not flown (in knots).

Max landing weight. Weight limit (in kilograms) at which aircraft can make a safe landing — either **unrestricted** (following normal landing procedures) or **at reduced sink rates** (following procedures that extend the landing over a longer-than-normal approach.)

Max range. For aircraft, how far it can travel (in nautical miles) without refueling.

Max power loading. Maximum aircraft weight divided by total propulsive power or thrust at takeoff (expressed in kilograms per kilo Newton).

Max T-O weights. Limit to which an aircraft can be loaded and still take off (in kilograms).

Max wing loading. Maximum amount wings can lift, calculated by dividing aircraft weight by wing area (in kilograms per square meter).

Max zero-fuel weight. Maximum weight without fuel (i.e., including avionics and weapons, in kilograms).

Muzzle velocity. For weapons, initial velocity of projectile (in meters/second).

Number of barrels. For weapons, the number of projectile barrels that can fire rounds simultaneously.

Operating weight empty. Aircraft weight that includes weight of all necessary avionic equipment (in kilograms), but no ordnance or fuel.

Propulsion. For weapons, method by which the weapon is propelled.

Rate of fire. For weapons, how many rounds can be fired per minute.

Rudders. Total surface area of aircraft's rudders (in square meters).

Tailplanes. Total surface area of aircraft's tailplanes (in square meters).

Tailplane span. Distance from one tip of aircraft's tailplanes to the opposing tip (in meters).

Warhead. For weapons, the type of explosive material carried.

Weight. Weight of the weapon (in kilograms).

Wheel track. For aircraft, distance between mainwheels, measured from center of each wheel (in meters).

Wheel base. For aircraft, distance between the nosewheel and mainwheel, measured from center of each wheel (in meters).

Wing span. For the aircraft or missile, distance between wingtips (in meters).

Wings, gross. Measure of wing slenderness as seen in plan view; square of the wingspan divided by the gross area (as a ratio).

F-15E Strike Eagle

Publication	*Jane's All the World's Aircraft*
Section	Aircraft - Fixed-Wing - Military
Country	United States Of America
Company	McDonnell Douglas - McDonnell Aircraft Company
Title	McDonnell Douglas F-15E Eagle; McDonnell Douglas F-15I Eagle; McDonnell Douglas F-15S Eagle; McDonnell Douglas F-15U Eagle; Israel Defense Force name: Ra'am (Thunder)
Type	Two-seat dual role attack/air superiority fighter

Programme

Demonstration of industry-funded Strike Eagle prototype (71-0291) modified from F-15B, including accurate blind weapons delivery, completed at Edwards AFB and Eglin AFB during 1982; product improvements for the F-15E were tested on four Eagles, amongst which were the Strike Eagle prototype, an F-15C and an F-15D, between November 1982 and April 1983, including first take-off at 34,019kg, 3,175kg more than F-15C with conformal tanks; new weight included conformal tanks, three other external tanks and eight Mk 82 bombs; 16 different stores configurations tested, including Mk 84 bombs, and BDU-38 and CBU-58 weapons delivered visually and by radar.

Full programme go-ahead announced 24 February 1984; first flight of first production F-15E (86-0183) 11 December 1986; first delivery to Luke AFB, Arizona, 12 April 1988; first delivery 29 December 1988 to 4th Wing at Seymour Johnson AFB, North Carolina. Small number of F-15Es used for trials with 3246th Test Wing at Eglin AFB, Florida, and 6510th TW (412th TW from October 1992) at Edwards AFB, California; trials include 87-0180 with GE F110-GE-129 engines in place of F100s; $5 million allocated in 1995 to allow USAF to complete test project. P&W F100-PW-229 first flown in F-15E of 6510th TW on 2 May 1990.

Variants

F-15E. Basic version, as detailed.

F-15F. Proposed single-seat version, optimized for air combat; not built.

F-15H. Proposed export version, lacking specialized air-to-ground capability; supplanted by F-15S.

F-15I. Israeli export version of F-15E; selected November 1993; confirmed 27 January 1994; 21 ordered 12 May 1994 for delivery from 1997 at one per month; option on four more converted to firm order in November 1995. Tactical electronic warfare system deleted; to be replaced by Israeli-built integrated system including active jamming, radar and missile warning, and dispenser subsystems. Otherwise identical to USAF F-15E, with F100-PW-229 engines, LANTIRN pods, full capability AN/APG-70 radar, Kaiser holographic HUD, Litton ring laser INS and VHSIC central computer. Associated equipment includes four Sanders mission planning subsystems and one Sanders common mapping production system (CMPS) to assist ground planning, briefing and debriefing activities at total cost of $6.2 million.

F-15S. Saudi Arabian export version of F-15E, lacking some air-to-air and air-to-ground capabilities; Saudi Arabian request for 72 aircraft approved by US government in December 1992; initially designated F-15XP; first funds assigned by US government on 23 December 1992; contract signature by Saudi government May 1993; planned delivery rate halved early 1994; now to be one per month from 1995. First F-15S flown 19 June 1995; official roll-out and handover 12 September 1995. Initial aircraft believed to have been retained in USA for trials; first two examples delivered to Saudi Arabia in November 1995 were second and third built.

Saudi versions comprise 24 optimized for air-to-air missions and 48 optimized for air-to-ground; largely outfitted with F-15C/D systems; AN/APG-70 radar 'detuned' to match AN/APG-63 performance, lacking computerized mapping; some ECM deleted; Lockheed Martin Sharpshooter reduced-capability version of LANTIRN nav/attack pods. Despite earlier planned restrictions, aircraft delivered with conformal fuel tanks and associated tangential stores attachments. Armament includes AGM-65D/G Maverick, AIM-9M and AIM-9S Sidewinder missiles, CBU-87 submunitions dispenser and GBU-10/12 bombs. Saudi programme includes about 154 Pratt & Whitney F100-PW-229 engines.

F-15U. Version conceived to satisfy United Arab Emirates requirement for 20 to 80 long-range interdictor aircraft, in which it is competing against Lockheed Martin F-16, Dassault Rafale, Eurofighter 2000 and Sukhoi Su-37 (Su-30MK). F-15U Plus proposal anticipates extended range, with additional 2,570kg of fuel in thicker clipped-delta, 50° leading-edge sweep wing; more stores stations and internally situated infrared navigation and targeting sensor suite in lieu of LANTIRN. Typical ordnance loads would comprise nine Mk 84 bombs or seven laser-guided GBU-24s.

Offer envisages co-development, with UAE funding cost of developing and testing any new components; alternative proposal envisages delivery to UAE of standard F-15E Strike Eagle under FMS; either option dependent upon US government policy, which is still to be established.

Costs

$35 million, flyaway; $2,000 million for 21 F-15Is (1993), Israel. $311 million appropriation for six F-15Es in FY96.

Design Features

NACA 64A aerofoil section with conical camber on leading-edge; sweepback 38° 42' at quarter-chord; thickness/chord ratio 6.6% at root, 3% at tip; anhedral 1°; incidence 0°. Twin fins positioned to receive vortex flow off wing and maintain directional stability at high angles of attack. Straight two-dimensional external compression engine air inlet each side of fuselage. Air inlet controllers by Hamilton Standard. Air inlet actuators by National Water Lift. Mission includes approach and attack at night and in all weather; main systems include new high-resolution, synthetic aperture Hughes AN/APG-70 radar, wide field of view FLIR, Lockheed Martin LANTIRN navigation (AN/AAQ-13) and targeting (AN/AAQ-14) pods beneath starboard and port air intakes respectively; air-to-air capacity with AIM-7 Sparrow, AIM-9 Sidewinder and AIM-120 AMRAAM retained; rear cockpit has four multipurpose CRT displays for radar, weapon selection, and monitoring enemy tracking systems; front cockpit modifications include redesigned up-front controls, wide field of view HUD, colour CRT multifunction displays for navigation, weapon delivery, moving map, precision radar mapping and terrain-following. Engines have digital electronic control, engine trimming and monitoring; fuel tanks are foam-filled; more powerful generators; better environmental control.

Flying Controls

Plain ailerons and all-moving tailplane with dog-tooth extensions, both powered by National Water Lift hydraulic actuators; rudders have Ronson Hydraulic Units actuators; no spoilers or trim tabs; Moog boost and pitch compensator for control column; plain flaps; upward-opening airbrake panel in upper fuselage between fins and cockpit. Digital triple-redundant Lear Astronics flight control system capable of automatic coupled terrain-following.

Structure

Wing based on torque box with integrally machined skins and ribs of light alloy and titanium; aluminum honeycomb wingtips, flaps and ailerons; airbrake panel of titanium, aluminum honeycomb and graphite/epoxy composites skin. Strike version of Eagle includes 60% of normal F-15 structure redesigned to allow 9G and 16,000 hours fatigue life; superplastic forming/diffusion bonding used for upper rear fuselage, rear fuselage keel, main landing gear doors, and some fuselage fairings, plus engine bay structure. New wing design that would provide 33 percent range increase and give double the number of weapons stations of existing F-15E revealed in 1994. This could be incorporated in future production aircraft (including proposed United Arab Emirates F-15U) or installed on existing F-15s as retrofit programme.

Landing Gear

Hydraulically retractable tricycle type, with single wheel on each unit. All units retract forward. Cleveland nose and main units, each incorporating an oleo-pneumatic shock-absorber. Bendix wheels and Michelin AIR X radial tires on all units. Nosewheel tyre size 22 x 7.75-9, mainwheel tires size 36 x 11-18; tyre pressure 21.03 bars (305 lb/sq in) on all units. Bendix five-rotor carbon disc brakes.

Power Plant

Initially, two Pratt & Whitney F100-PW-220 turbofans, each rated for take-off at 104.3 kN, installed, with afterburning. USAF aircraft 135 onwards (90-0233), built from August 1991, have 129.4 kN Pratt & Whitney F100-PW-229s, which also ordered for Saudi F-15S. Internal fuel in foam-filled structural wing tanks and six Goodyear fuselage tanks, total capacity 7,643 litres (2,019 US gallons; 1,681 Imp gallons). Simmonds fuel gauge system. Optional conformal fuel tanks (CFT) attached to side of engine air intakes, beneath wing, each containing 2,737 litres (723 US gallons; 602 Imp gallons). Provision for up to three additional 2,309 litre (610 US gallon; 508 Imp gallon) external fuel tanks. Maximum total internal and external fuel capacity 20,044 litres (5,295 US gallons; 4,409 Imp gallons).

Accommodation

Two crew, pilot and weapon systems officer, in tandem on McDonnell Douglas ACES II zero/zero ejection seats. Single-piece, upward-hinged, bird-resistant canopy.

Systems

Lucas Aerospace generating system for electrical power, with Sundstrand 60/75/90 kVA constant-speed drive units. Litton molecular sieve oxygen generating system (MSOGS) introduced in 1991 to replace liquid oxygen system. AiResearch air conditioning system. Three independent hydraulic systems (each 207 bars; 3,000 lb/sq in) powered by Abex engine-driven pumps; modular hydraulic packages by Hydraulic Research and Manufacturing Company. AlliedSignal APU for engine starting, and for provision of limited electrical or hydraulic power on the ground independently of main engines.

Armament

20mm M61A1 six-barrel gun in starboard wing-root, with 512 rounds (see **M61A1 Vulcan Cannon**, p. 276). General Electric lead computing gyro. Provision on underwing (one per wing) and centerline pylons for air-to-air and air-to-ground weapons and external fuel tanks. Wing pylons use standard rail and launchers for AIM-9 Sidewinder and AIM-120 AMRAAM air-to-air missiles; AIM-7 Sparrow and AIM-120 AMRAAM can be carried on ejection launchers on the fuselage or on tangential stores carriers on CFTs. Maximum aircraft load (with or without CFTs) is four each AIM-7 or AIM-9, or up to eight AIM-120. (See **AIM-7 Sparrow**, p. 278, **AIM-9 Sidewinder**, p. 280, and **AIM-120 AMRAAM**, p. 282.) Single or triple rail launchers for AGM-65 Maverick air-to-ground missiles can be fitted to wing stations only. (See **AGM-65 Maverick**, p. 284.)

Tangential carriage on CFTs provides for up to six bomb racks on each tank, with provision for multiple ejector racks on wing and centerline stations. Edo BRU-46/A and BRU-47/A adapters throughout, plus two LAU-106A/As each side of lower fuselage. F-15E can carry a wide variety and quantity of guided and unguided air-to-ground weapons, including Mk 20 Rockeye, Mk 82, Mk 84, BSU-49, BSU-50, GBU-10, GBU-12, GBU-15, GBU-24, CBU-52, CBU-58, CBU-71, CBU-87 or CBU-89 bombs; SUU-20 training weapons; A/A-37 U-33 tow target; and B57 and B61 series nuclear weapons. An AN/AXQ-14 datalink pod is used in conjunction with the GBU-15; LANTIRN pod illumination is used to designate targets for laser-guided bombs; AGM-130 powered standoff bomb integrated in 1993. AN/AWG-27 armament control system.

Avionics

Comms. Magnavox AN/ARC-164 UHF transceiver and UHF auxiliary transceiver with cryptographic capability; Teledyne Electronics AN/APX-101 IFF transponder; Hazeltine AN/APX-76 IFF interrogator with Litton reply evaluator.

Radar. Hughes Aircraft AN/APG-70 I-band pulse Doppler radar provides air-to-air capability equal to F-15C, plus high-resolution synthetic aperture mode for air-to-ground. (See **AN/APG-70 Radar for the F-15E**, p. 252.)

Flight. Triple redundant Lear Astronics digital flight control system with automatic terrain-following standard. IBM CP-1075C very high-speed integrated circuit (VHSIC) central computer introduced in 1992 (replacing CP-1075). Honeywell AN/ASK-6 air data computer, Honeywell AN/ASN-108 AHRS, Honeywell CN-1655A/ASN ring laser gyro INS providing basic navigation data and serving as primary attitude reference system, Collins AN/ARN-118 Tacan, Collins HSI presenting aircraft navigation information on a symbolic pictorial display, Collins AN/ARN-112 ILS receiver, Collins ADF receiver, Dorne & Margolin glide slope localiser antenna and Teledyne Avionics angle of attack sensors. Collins miniature airborne GPS receiver for installation from 1995.

Instrumentation. FLIR imagery displayed on Kaiser IR-2394/A wide field of view HUD; Honeywell vertical situation display set using CRT to present radar, electro-optical identification and attitude director indicator formats to pilot under all light conditions; moving map display by Bendix/King RP-341/A remote map reader. Honeywell digital map system intended to replace remote map reader from 1996.

Mission. Lockheed Martin LANTIRN externally mounted sensor package comprising AN/AAQ-13 navigation pod and AN/AAQ-14 targeting pod. (See **LANTIRN System**, p. 254.)

Self-defense. Northrop Grumman Enhanced AN/ALQ-135(V) internal countermeasures set provides automatic jamming of enemy radar signals; Loral AN/ALR-56C RWR, Magnavox AN/ALQ-128 EW warning set, Tracor AN/ALE-45 chaff dispenser. (See **AN/ALQ-135 Jamming System**, p. 272.)

Specifications

DIMENSIONS (EXTERNAL)	
Wing span	13.05m
Wing aspect ratio	3.0
Length overall	19.43m
Height overall	5.63m
Tailplane span	8.61m
Wheel track	2.75m
Wheel base	5.42m

AREAS	
Wings, gross	56.49m^2
Ailerons (total)	2.46m^2
Flaps (total)	3.33m^2
Fins (total)	9.78m^2
Rudders (total)	1.85m^2
Tailplanes (total)	10.34m^2

WEIGHTS AND LOADINGS (F100-PW-220 Engines)	
Operating weight empty[1]	14,515kg
Max weapon load	11,113kg
Max fuel weight	
internal (JP-4)	5,952kg
CFTs (two)	4,265kg
external tanks (three)	5,396kg
internal and external	15,613kg
Max T-O weight	36,741kg
Max zero-fuel weight	28,440kg
Max landing weight	
unrestricted	20,094kg
at reduced sink rates	36,741kg
Max wing loading	650.5kg/m^2
Max power loading	176kg/kN

PERFORMANCE	
Max combat radius	685nm
Max range	2,400nm

[1] No fuel, ammunition, pylons or external stores

Avionics

AN/ALQ-135 Jamming System

Publication	*Jane's Radar And Electronic Warfare Systems*
Date	19950613
Section	Airborne ECM Systems
Country	United States Of America
Title	AN/ALQ-135 Jamming System
Type	Airborne radar jamming system

Description

The Internal Countermeasures Set (ICS) is a component of the tactical electronic warfare system for the US Air Force F-15 Eagle fighter. It is installed in varying configurations for the F-15A, F-15C and F-15E. The AN/ALQ-135 operates with the AN/ALR-56 radar warning system and the AN/ALQ-45 countermeasures dispenser.

The AN/ALQ-135 is an advanced jamming system employing high-powered transmitters. All equipment is mounted internally and jamming management is self-contained for the F-15C and F-15E. The system features automatic jamming of threat radars and its dual mode ability allows both pulse and CW threats to be countered. The computer management system enables the ALQ-135 to adapt automatically to changes in hostile transmissions.

The basic AN/ALQ-135 consisted of two line-replaceable units (LRUs) plus associated waveguides and a four-antenna array. It comprised one Band 1 jammer and two Band 2 jammers. Over the years, the system has continued to evolve with the capability of the aircraft and changes in the threat.

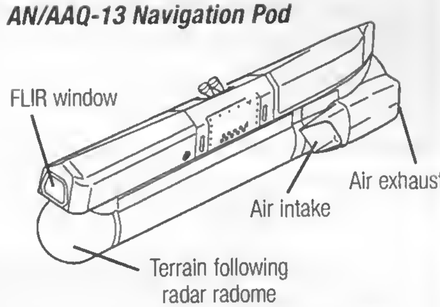
LANTIRN System

Publication	*Jane's Avionics*
Section	Electro-Optics
Country	United States Of America
Title	LANTIRN System

Description

The Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) system consists of two pods: the AN/AAQ-13 navigation pod and the AN/AAQ-14 targeting pod. LANTIRN provides the means by which F-15E and F-16C/D aircraft can penetrate hostile airspace at extremely low altitude and high speed, acquire their targets and deliver guided and unguided weapons around the clock.

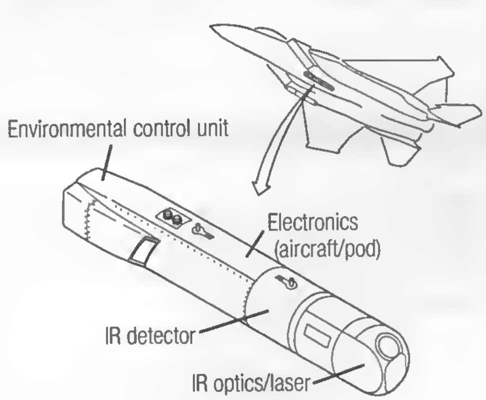
AN/AAQ-13 Navigation Pod



The LANTIRN system consists of two separate sets of equipment each contained in its own pod, suitable for underwing or underfuselage attachment. Either or both pods can be carried, depending on the particular mission requirement.

The AN/AAQ-13 navigation pod contains a wide field of view FLIR unit and a terrain-following radar. FLIR imagery from the pod is displayed on a wide field of view holographic head-up display.

AN/AAQ-14 Targeting Pod



The AN/AAQ-14 targeting pod contains a stabilization system, wide and narrow field FLIR, laser designator/ranger, automatic multimode tracker, automatic infrared Maverick missile hand-off system, environmental control unit, pod control computer, power supply and provision for an automatic target recognizer. The targeting pod interfaces with the aircraft controls and displays as well as the fire control system to permit low-level day and night manual target acquisition and semi-automatic weapon delivery of guided and unguided weapons.

AN/APG-70 Radar

Publication	*Jane's Avionics*
Section	Radar
Country	United States Of America
Title	AN/APG-70 Radar for the F-15E

Description

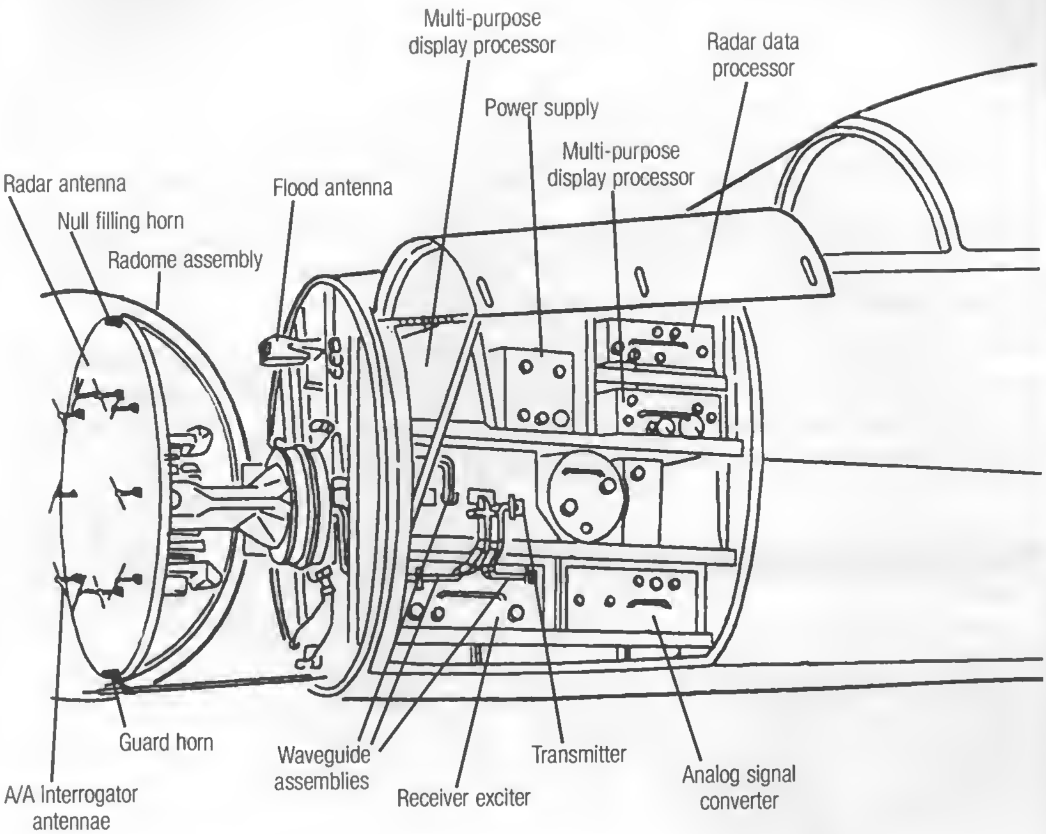
The radar for the two-seat McDonnell Douglas F-15E combat aircraft is a substantially improved version of the APG-63, designated AN/APG-70. It has also been chosen to upgrade the C/D versions of the F-15 under the US Air Force's Multi-Staged Improvement Programme (MSIP). By comparison with the earlier system, the APG-70 has a far greater RF bandwidth, a larger look-down target detection range, a one-third increase in MTBF and is packaged in seven units instead of eight.

The system is compatible with existing and new missiles such as AIM-7F/M Sparrow, AIM-9L Sidewinder and AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM), and with 20mm cannon.

In the air-to-air role the radar has four search modes: range-while-scan with high PRF, medium PRF or interleaved PRF, and velocity search. The radar also has single target track, track-while-scan and raid assessment track modes and vertical search, super search, boresight and auto-guns target acquisition modes.

In the air-to-ground role the radar can produce a high resolution or a real-beam ground map; the specification calls for 8.5ft resolution at 20nm range.

SPECIFICATIONS	
Volume	$0.25m^3$
Weight	251kg
Frequency	8-20 MHz selectable
PRF	multiple
Number of LRUs	6


Multi-purpose
display processor
Radar data
processor
Power supply
Multi-purpose
display processor
Radar antenna
Flood antenna
Null filling horn
Radome assembly
Guard horn
A/A Interrogator
antennae
Waveguide
assemblies
Receiver exciter
Transmitter
Analog signal
converter

Weapons

M61A1 Vulcan Cannon

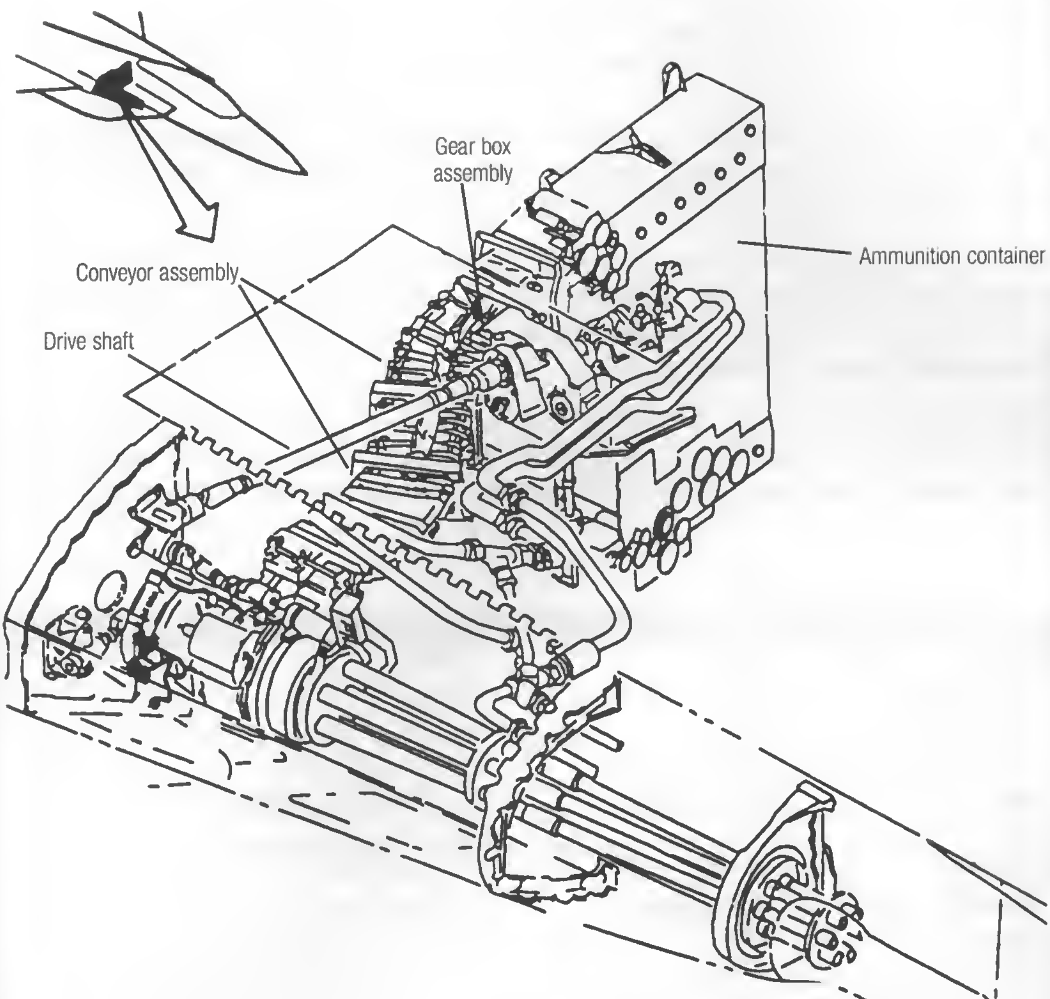
Publication	*Jane's Air-Launched Weapons*
Section	Guns, Pods And Mountings
Country	United States Of America
Title	M61A1 Vulcan Cannon
Type	20mm Gatling type cannon for aircraft

The M61A1 is a 20mm six-barreled, Gatling type cannon having a rotary action powered from the aircraft's hydraulic or electrical supply. A typical installation with one cannon and 500 rounds of ammunition weighs about 196kg.

When the cannon is fired the rotor revolves anti-clockwise looking in the direction of fire. Cam followers operate the bolt for each barrel, successively chambering, firing and extracting the rounds as the gun rotates.

The Vulcan family of cannons fire standard 20 x 120mm ammunition such as the M50 series also used for the French M621 and US M36 cannon. These include the M56 High-Explosive, M56A1 High-Explosive Incendiary, M53A1 Armour-Piercing Incendiary and M55A1 Practice Ball rounds.

SPECIFICATIONS	
Calibre	20mm
Number of barrels	6
Length	1.83m
Weight	114.5kg
Rate of fire	4,000 or 6,000 rds/min (selectable)
Muzzle velocity	1,030 m/s


Gear box assembly
Ammunition container
Conveyor assembly
Drive shaft

AIM-7 Sparrow

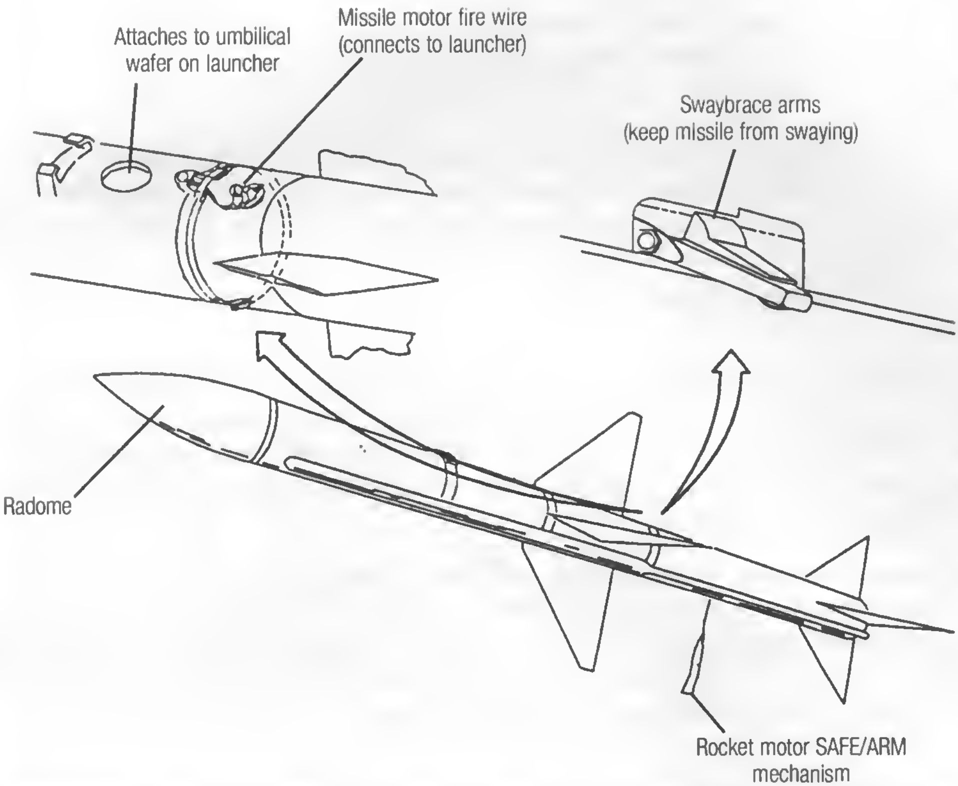
Publication	*Jane's Air-Launched Weapons*
Section	Air-To-Air Missiles
Country	United States Of America
Title	AIM-7 Sparrow
Type	Medium-range, radar-guided, air-to-air missile

The AIM-7 Sparrow 3 missile is an all-weather, all-aspect air-to-air missile which has also been adapted for use with shipboard air defense. The missile has four moving delta-wings at the middle and four fixed delta fins at the rear.

The AIM-7F models were the first Sparrow missiles to use all-solid-state electronics; this condensed the guidance section, which allowed the warhead to be moved forward of the wings and allowed the use of a more powerful motor to increase both speed and range.

The AIM-7M version has an inverse monopulse semi-active seeker which, with digital processing, greatly improves the missile's performance under heavy ECM and weather conditions. This model also has the advantage of an active radar fuze.

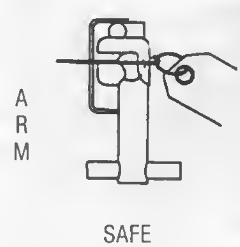
SPECIFICATIONS	AIM-7F	AIM-7M
Length	3.66m	3.66m
Body diameter	203mm	203mm
Wingspan	1.02m	1.02m
Launch weight	227kg	230kg
Warhead	39kg HE continuous	39kg HE blast/fragmentation
Fuze	RF	Active radar
Guidance	Semi-active radar	Semi-active radar
Propulsion	Solid propellant	Solid propellant
Range	40km	45km



Rocket motor SAFE/ARM mechanism

To ARM:
1. Pull handle to unlock
2. Raise handle
3. Rotate handle counterclockwise to ARM position
4. Lower handle

To SAFE:
1-2. As above
3. Rotate handle clockwise to SAFE position
4. Lower handle



AIM-9 Sidewinder

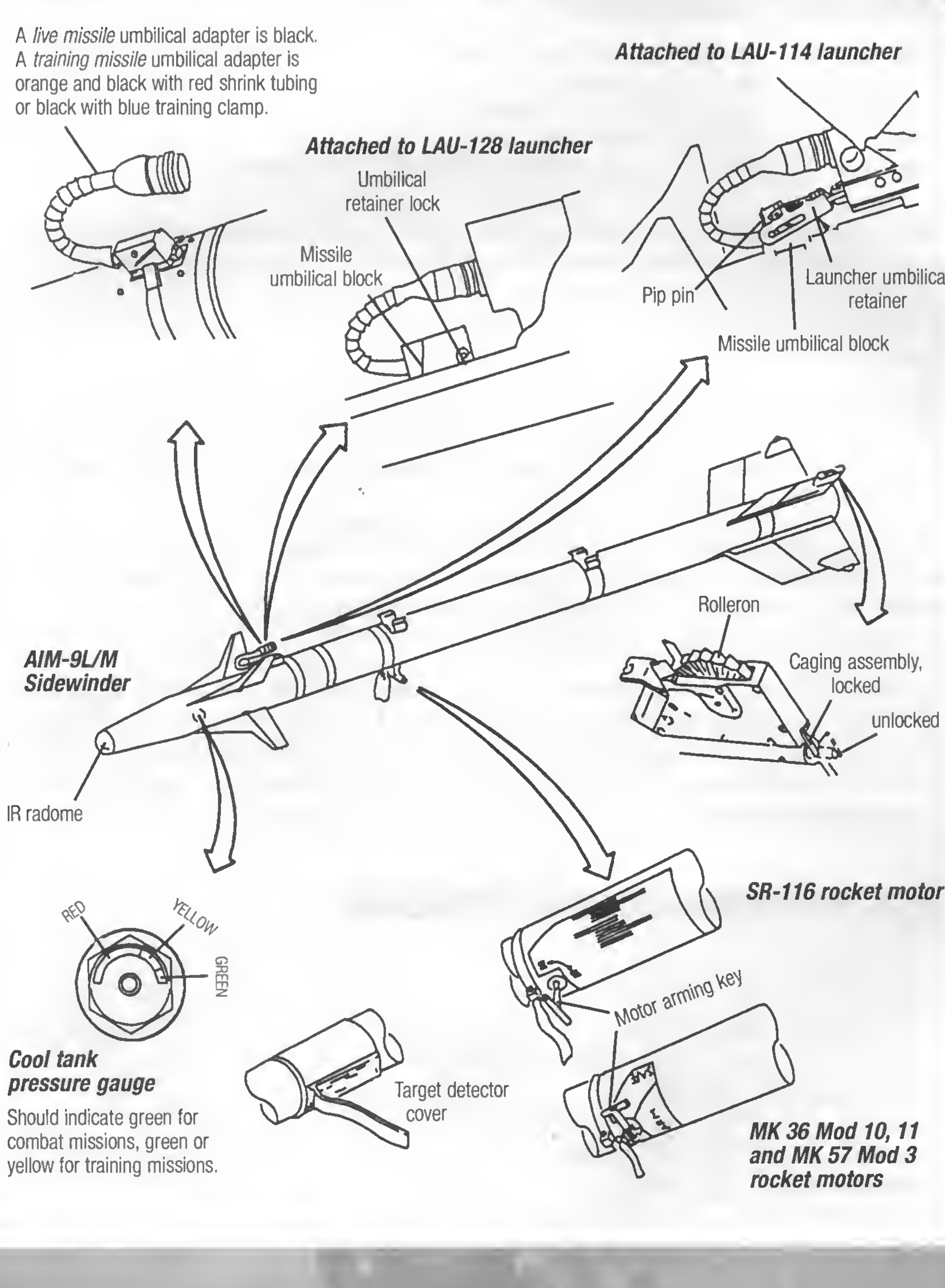
Publication	*Jane's Air-Launched Weapons*
Section	Air-To-Air Missiles
Country	United States Of America
Title	AIM-9 Sidewinder
Type	Short-range, IR air-to-air missile

The AIM-9 Sidewinder missile has four swept front control fins and four clipped delta-wings at the tail with the distinctive rollerons at the trailing-edge tips. Several modes can be used depending upon the avionics fit in the carrying aircraft; primarily there is the simple boresight mode, an uncaged scan mode and a mode with the missile seeker slaved to the aircraft radar or to a helmet-mounted sight.

The AIM-9M version is known as AIM-9S in USAF service. The AIM-9P versions are 3.07m long, have a body diameter of 127mm, a wingspan of 0.64m and weigh 82kg. These missiles, in the 9P-3 and 9P-4 later models, have an all-aspect engagement capability; in addition, 9P-4 has an active laser fuze. AIM-9P-5 has additional IRCCM capability.

AIM-9R was basically the same as AIM-9M but with a visual band CCD seeker and microcomputer tracker. An improved seeker with dual mode, thought to be visual and IR, is believed to be in design for later Sidewinder (AIM-9X or Sidewinder 2000) versions as well as reduced size wings and fins to give a smaller radar cross-section and less aerodynamic drag.

SPECIFICATIONS	AIM-9L/9M	AIM-9P
Length	2.87m	3.07m
Body diameter	127mm	127mm
Wingspan	0.64m	0.64m
Launch weight	87kg	82kg
Warhead	9.5kg HE blast/fragmentation	12kg HE blast/fragmentation
Fuze	Active laser	RF or active laser
Guidance	IR	IR
Propulsion	Solid propellant	Solid propellant
Range	8km	8km


A *live missile* umbilical adapter is black. A *training missile* umbilical adapter is orange and black with red shrink tubing or black with blue training clamp.
Attached to LAU-128 launcher
Umbilical retainer lock
Missile umbilical block
Attached to LAU-114 launcher
Pip pin
Launcher umbilical retainer
Missile umbilical block
AIM-9L/M Sidewinder
IR radome
Rolleron
Caging assembly, locked
unlocked
RED
YELLOW
GREEN
Cool tank pressure gauge
Should indicate green for combat missions, green or yellow for training missions.
Target detector cover
SR-116 rocket motor
Motor arming key
MK 36 Mod 10, 11 and MK 57 Mod 3 rocket motors

AIM-120 AMRAAM

Publication	*Jane's Air-Launched Weapons*
Section	Air-To-Air Missiles
Country	United States Of America
Title	AIM-120 AMRAAM
Type	Medium-range, radar-guided, air-to-air missile

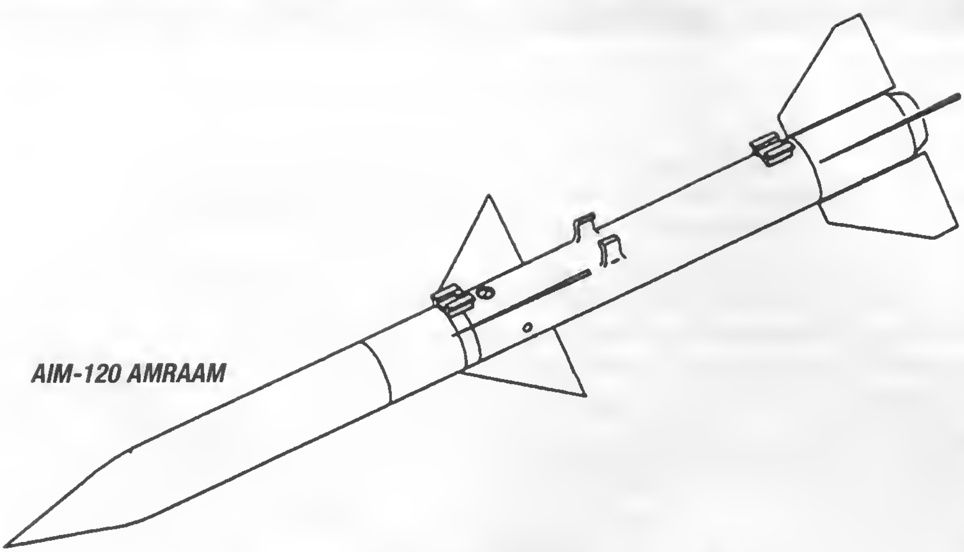
AIM-120 AMRAAM is an all-weather, all-aspect, active radar-guided missile, powered by a solid propellant motor and armed with a fragmentation warhead. It is generally similar in configuration to the AIM-7 Sparrow it replaces, but the new weapon is distinguished by its smaller wings, greater range, and improved reliability.

AMRAAM has a modular construction and consists of several major sections: the guidance unit, the electronics unit, the guidance inertial reference unit, the armament section, the rocket motor and actuator sections, and the command link receiver antennas.

The warhead is filled with 198 separate "candy bar"-shaped projectiles, and it is reported that the proximity fuzing system can sense which side of the missile a target is on and direct the blast/projectiles towards the target rather than being distributed in an even, circular pattern.

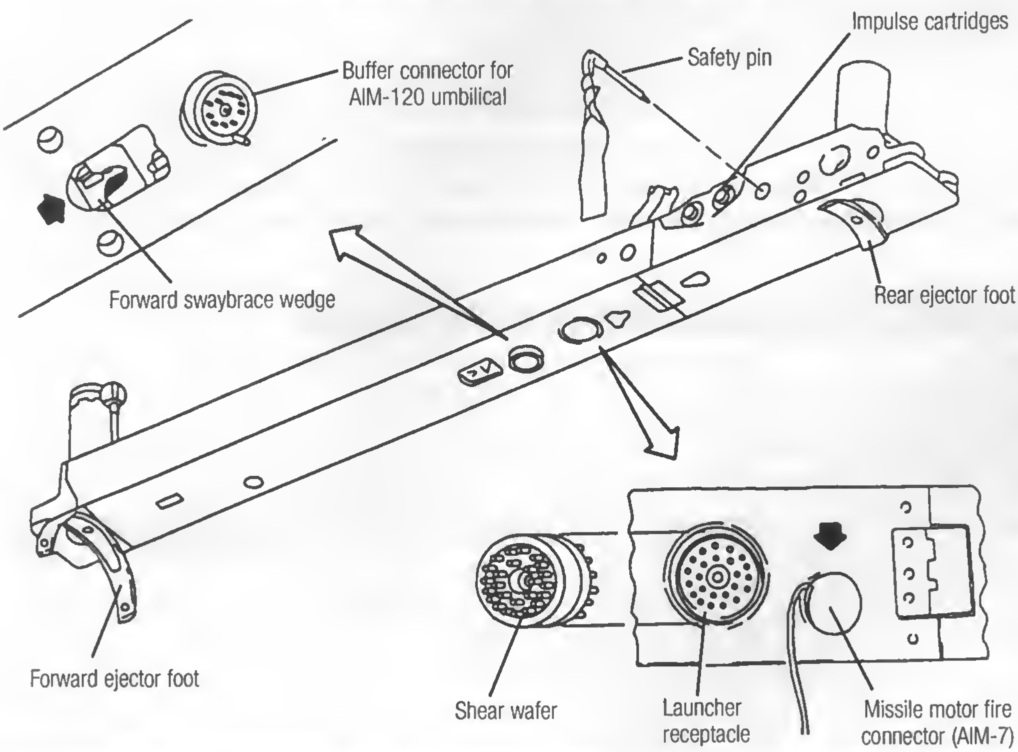
Guidance is by an active radar terminal seeker that has the ability to lock on after launch, using mid-course guidance based on target position and velocity vectors, both of which are provided by the launch aircraft (both before and after launch). In consequence there are several guidance modes depending on launch range and conditions.

SPECIFICATIONS	
Length	3.65m
Body diameter	178mm
Wingspan	0.63m
Launch weight	157kg
Warhead	22kg HE directed fragmentation
Fuze	Active radar
Guidance	Command, inertial and active radar
Propulsion	Solid propellant
Range	50km



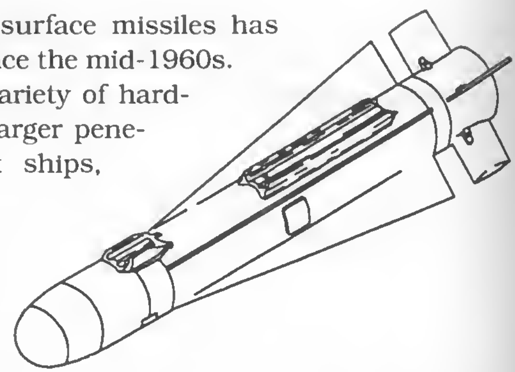
AIM-120 AMRAAM

LAU-106 Missile Launcher (for AIM-120 and AIM-7)



AGM-65D/G Maverick

Publication	*Jane's Air-Launched Weapons*
Section	Air-To-Surface Missiles
Country	United States Of America
Title	AGM-65 Maverick
Type	Short- and medium-range, TV-, IIR- and laser-guided, air-to-surface missiles



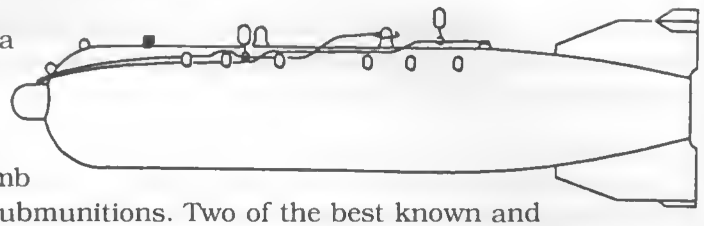
The AGM-65 Maverick family of air-to-surface missiles has been steadily developed and improved since the mid-1960s. Designed for use against tanks and a variety of hardened targets, the later versions have a larger penetrating warhead specifically to attack ships, bunkers and hardened aircraft shelters.

Before launch the pilot climbs to get a good view of the target, selects a missile and obtains a picture from the missile tracker on the display. A target is then selected from the display screen, cross-hairs are set over the target and the missile launched. The missile homes to the designated target and the launch aircraft is free to break away immediately after launch. Guidance for the A and B versions is by TV tracker, and for the D, F and G versions by an IIR seeker. The AGM-65E operates on a quite different principle, with the missile homing onto coded laser energy reflected from the target.

SPECIFICATIONS	AGM-65D	AGM-65F/G
Length	2.49m	2.49m
Body diameter	305mm	305mm
Wingspan	0.72m	0.72m
Launch weight	220kg	307kg
Warhead	57kg HE shaped charge	136kg blast penetrator
Fuze	Impact	Impact
Guidance	IIR	IIR
Propulsion	Solid propellant	Solid propellant
Range	3km	25km

CBU-52, CBU-58 and CBU-71

Publication	*Jane's Air Launched Weapons*
Section	Bombs
Country	United States Of America
Title	SUU-30 Dispensers (With CBU-52/58)
Type	Multipurpose cluster bombs



Each CBU comprises a dispenser (Suspended Underwing Unit (SUU)) or cluster adapter loaded with the appropriate Bomb Live Unit (BLU) or other submunitions. Two of the best known and most widely used of these dispensers are the SUU-30 and the Mk 7 (Rockeye).

The following list covers the known different types of CBUs using SUU-30s and believed to be still in service: CBU-52 (254 BLU-61 fragmentation bomblets), CBU-53 (670 BLU-70 incendiary bomblets), CBU-54 (670 BLU-68 incendiary bomblets), CBU-58 (650 BLU-63 fragmentation bomblets), CBU-62 (2025 M38 fragmentation grenades), CBU-68 (BLU-48 fragmentation bomblets), CBU-70 (unspecified submunitions) and the CBU-71 (670 BLU-86A fragmentation bomblets).

The nose fuze used with all variants of the SUU-30 is believed to be the air driven Mk 339. It provides ground-selected options for varying dispenser opening times, ensures safe separation from the aircraft prior to arming and initiates the opening of the body casing allowing bomblets/mines to be released. These are then dispersed over the target area by aerodynamic forces and descend to the ground. The size and shape of impact areas can be changed according to aircraft speed, altitude, dive angle and the dispenser opening time.

The SUU-30 dispenser is in service with the US forces and is believed to have been exported, but details are unknown. At least two versions of the SUU-30 were used in the 1991 Gulf War against soft targets, the CBU-52 and CBU-58.

SPECIFICATIONS	CBU-52	CBU-58
Length	2.33 m	2.33 m
Body diameter	430 mm	430 mm
Tailspan	0.58 m	0.58 m
Lug spacing	356 mm	356 mm
Weight	370 kg	430 kg
Filling	254 BLU-61s	650 BLU-63s

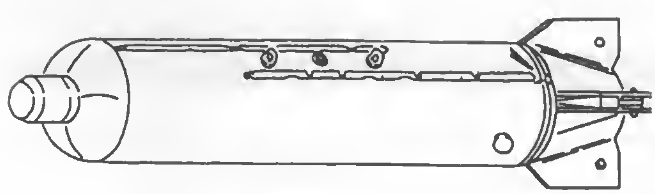
CBU-87 (with BLU-97 bomblets)

Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	United States Of America
Title	CBU-87/B Combined Effects Munition (CEM) (with BLU-97)
Type	Multipurpose cluster bomb

The CBU-87 is a thin-walled cylindrical bomb-like weapon with a hemispherical nose, a cruciform tail unit comprising four extending fins and a nose-mounted fuzing system.

The BLU-97 bomblet is basically a cylindrical canister-type bomb fitted with a ballute parachute retarding tail unit, and an ejection front-projecting tube used to sense the optimum standoff distance for activating the shaped charge explosive. Before release the aircrew can select either one of two delivery modes for the CBU — timed or proximity. In the timed mode the cluster bomb opens at a preset time after weapon release.

SPECIFICATIONS	CBU-87	BLU-97 CEM Bomblet
Length	2.33m	0.169m stowed
Body diameter	396mm	64mm
Tailspan	0.52m closed, 1.07m extended	n/a
Lug spacing	356mm	n/a
Weight	430kg	1.5kg
Filling	202 BLU-97/B bomblets Zirconium	287 g 70/30 Cyclotol



CBU-87

CBU-97 (with BLU-108 bomblets)

Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	United States Of America
Title	CBU-97/B Sensor Fuzed Weapon System (SFW) (with BLU-108)
Type	Anti-tank cluster bomb

The CBU-97 Sensor Fuzed Weapon system (SFW) was developed by Textron Defense Systems in order to provide the USAF with a 'Smart' anti-tank cluster bomb capable of destroying present and future Main Battle Tanks (MBT) by attacking their top armour.

The SFW is based on the Suspended Underwing Unit (SUU)-65 also known as the Tactical Munition Dispenser (TMD), which was designed to release a wide variety of submunitions/bomblets. When used in its CBU-97 configuration, the TMD carries 10 specially developed submunitions which in turn each carry four Skeet 'Smart' anti-armour warheads that use infrared sensors to detect armoured targets. The submunition is designated BLU-108.

SPECIFICATIONS	CBU-97	BLU-108 Bomblet
Length	2.34m	0.88m stowed
Body diameter	406mm	118mm
Tailspan	0.52m closed, 1.07m extended	0.17m
Lug spacing	356mm	n/a
Weight	450kg	n/k
Filling	10 BLU-108/B bomblets	4 Skeet warheads

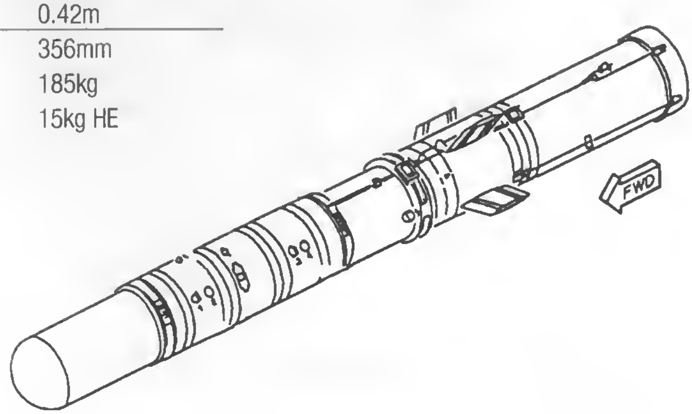
Durandal (BLU-107)

Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	France
Title	Durandal
Type	Penetration bomb

The Durandal bomb was developed in the early to mid-1970s by Matra SA in collaboration with SAMP to meet a French Air Force requirement for an anti-runway weapon to be used in the disablement of airfields and concrete shelter neutralization by low level attack.

At impact the contact fuze is activated and after a short delay the warhead explodes. As an option, the explosion may be delayed for several hours by manual selection prior to take-off. The detonation of the warhead from beneath the runway surface results in a crater several metres in diameter, 2 to 3m deep, surrounded by a large area where slabs have been raised and cracked.

SPECIFICATIONS	
Length	2.49m
Body diameter	223mm
Tailspan	0.42m
Lug spacing	356mm
Weight	185kg
Warhead	15kg HE



GBU-15 Modular Guided Weapon System

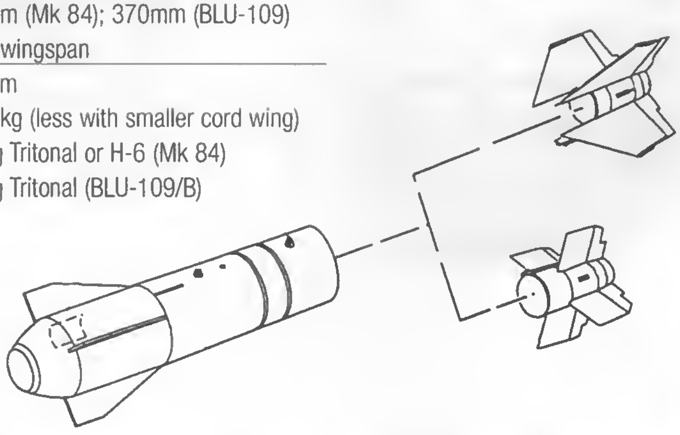
Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	United States Of America
Title	GBU-15 Modular Guided Weapon System
Type	TV or IR-guided bomb

The GBU-15(V)-1 and -2 are basically Mk 84 general purpose bombs or BLU-109 penetrating bombs fitted with a TV or IIR seeker head and a set of aerodynamic control surfaces.

Required equipment for the GBU-15 launch/control aircraft includes a datalink pod, cockpit pod control, suitable electro-optical display and controls and a hand control for the seeker. Video is transmitted continuously from the weapon to the control aircraft; commands from the aircraft to the weapon are only transmitted when the weapon operator is controlling movement of the seeker head or commanding lock on.

After launch the weapon performs a programmed climb and the operator acquires the target shortly afterwards. The operator then has the option to lock on to the aim point or manually track it. Alternatively, GBU-15 can be used in the 'buddy' control mode, where one aircraft delivers the weapon and another performs the control functions.

SPECIFICATIONS	
Length	3.94m
Body diameter	460mm (Mk 84); 370mm (BLU-109)
Tailspan	1.5m wingspan
Lug spacing	762mm
Weight	1,140kg (less with smaller cord wing)
Filling	428kg Tritonal or H-6 (Mk 84)
	240kg Tritonal (BLU-109/B)



GBU-10/E/G, GBU-12/D and GBU-24/A Paveway Laser-Guided Bomb Systems

Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	United States Of America
Title	Paveway Laser-Guided Bomb Systems (GBU-10/11/12/16/17/24)
Type	Laser-guided bombs

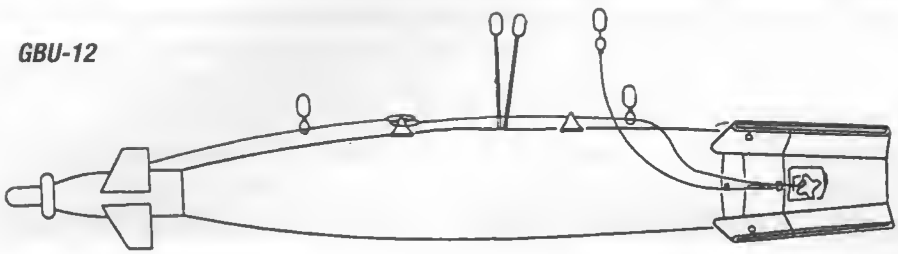
During the 1991 Gulf War it was revealed that the F-117A Nighthawk stealth combat aircraft was involved in laser-guided bomb (LGB) attacks against high value strategic targets and bunker command posts. It was also revealed that two new types of penetrating LGBs had been employed which up until then were programmes that had been shrouded in secrecy. The first of these was a modified Paveway III designated GBU-27, and the other weapon was the GBU-28 that had been developed for deep bunker penetration and used modified GBU-27 guidance and control components.

The Paveway III GBU-24 and -24A use the same warheads as the GBU-10C and -10G respectively. Guidance for all Paveway LGBs is by semi-active laser. After the bomb is released the laser error detector measures the angle between the bomb's velocity vector and the line between the bomb and target. Steering corrections are made by moving the nose-mounted canard control fins to adjust the bomb's trajectory to line up with the target.

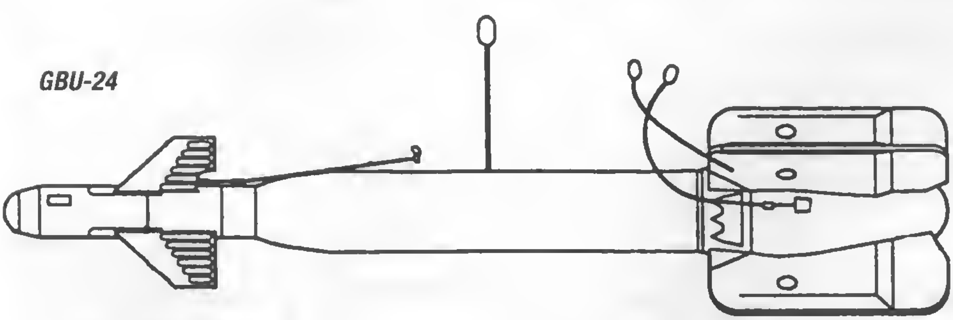
SPECIFICATIONS	GBU-10E	GBU-10G	GBU-12D
Length	4.32m	4.26m	3.33m
Body diameter	460mm	370mm	273mm
Tailspan	0.72m closed 1.68m extended	0.72m closed 1.68m extended	0.43m closed 1.34m extended
Lug spacing	762mm	762mm	356 or 762mm
Weight	900kg approx	900kg approx	225kg
Filling	428kg Tritonal	240kg Tritonal	89kg Tritonal

SPECIFICATIONS	GBU-24	GBU-24A
Length	4.39m	4.31m
Body diameter	460mm	370mm
Tailspan	0.94m closed 2.0m extended	0.94m closed 2.0m extended
Lug spacing	762mm	762mm
Weight	900kg approx	900kg approx
Filling	428kg Tritonal	240kg Tritonal

GBU-12



GBU-24



GBU-28 Laser-Guided Penetration Bomb

Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	United States Of America
Title	GBU-27, 28 Penetration Bomb, Laser-Guided Penetration Bombs
Type	Laser-guided bomb

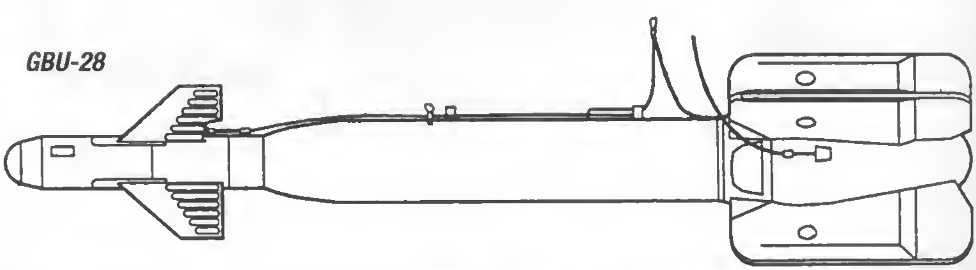
The GBU-27 and GBU-28 both use the same basic laser guidance system and control surfaces that are used by the GBU-24 Paveway III system, and a folding stabilizing tail unit developed from the GBU-10 series.

These LGBs are made up of three major components; a common laser guidance and control section, the main body warhead with suspension lugs, and a common stabilizing tail unit. Guidance is by semi-active laser, the scanning detector assembly and laser energy receiver being mounted in the front of the canister behind the glass dome. After the bomb is released the laser error detector measures the angle between the bomb's velocity vector and the line between the bomb and target. Steering corrections are made by moving the nose-mounted canard control fins to adjust the bomb's trajectory to line up with the target.

Depending on the angle of impact, the GBU-27 is reported to be capable of penetrating between 1.8 and 2.4m of reinforced concrete. The GBU-28 is credited with the ability to penetrate 30m of earth or 6m of concrete.

SPECIFICATIONS	GBU-28
Length	5.84m
Body diameter	370mm
Tailspan	0.72m closed 1.68m extended
Lug spacing	n/k
Weight	2,130kg
Filling	306kg Tritonal

GBU-28



Mk 82 and Mk 84

Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	United States Of America
Title	Low Drag General Purpose Bombs Mk 81/82/83/84, BLU-110/111
Type	General purpose bombs

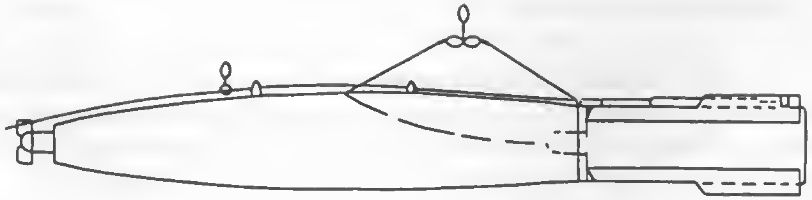
Development of this range of low drag general purpose bombs for use by the United States armed forces began in the 1950s. The four bombs developed were the Mk 81 (113kg), Mk 82 (227kg), Mk 83 (454kg) and Mk 84 (908kg).

This family of bombs has formed the basis of several other weapon programmes such as the Laser-Guided Bombs (Paveway) and Electro-Optically Guided Bombs (GBU-15 and AGM-62 Walleye).

The Mk 81, Mk 82, Mk 83 and Mk 84 bombs differ only in size, weight and destructive capacity. The explosive charge is either Tritonal, Minol, H-6 or PBXN-109.

SPECIFICATIONS	Mk 82	Mk 84
Length	2.21m	3.84m
Body diameter	273mm	460mm
Tailspan	0.38m	0.64m
Lug spacing	356 or 762mm	762mm
Weight	241kg	894kg
Filling	89kg Tritonal, Minol, or H-6	428kg Tritonal or H-6

Mk-82



Mk 20 Rockeye II

Publication	*Jane's Air-Launched Weapons*
Section	Bombs
Country	United States Of America
Title	MK 6, 7 (Rockeye ll) Dispenser/lSCB-1/CBU-59
Type	Multipurpose cluster bomb

Since the Second World War more than 100 types of air-launched dispenser weapons have been developed and entered service with the US forces. The early weapons, some of which are still in service, fall into the M and Mk series, while the newer weapons are generally listed as Cluster Bomb Units (CBUs). Each of these CBUs comprises a dispenser (Suspended Underwing Unit (SUU)) or cluster adapter loaded with the appropriate Bomb Live Unit (BLU) or other submunitions. Two of the best known and most widely used of these dispensers still in service are the Mk 7 (Rockeye II) and the SUU-30.

The Mk 7 dispenser is believed to have been developed in the early 1960s, and in the mid-60s was adapted to provide US forces with an air-launched cluster bomb for attacking tanks, armoured vehicles and soft targets. The Rockeye II Mk 20 system was designed to carry 247 dual-purpose anti-armour bomblets, and was fitted with a newly developed nose-mounted fuze system to control the opening of the Mk 7 dispenser at a predetermined altitude. The bomblet was designated Mk 118 and the new fuze Mk 339. After extensive testing the Rockeye ll system entered service in the early 1970s.

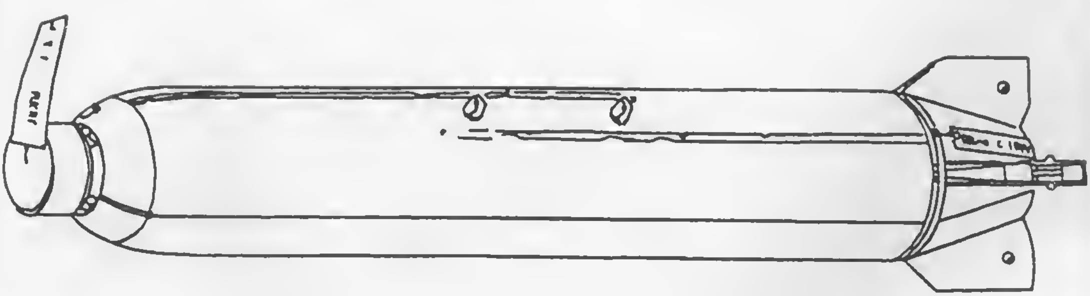
The Mk 7 dispenser is a bomb-like weapon with a cylindrical body that has an ogival nose, a cruciform tail unit comprising four fixed extending fins and a nose-mounted fuzing system.

When used as the Rockeye Il cluster bomb system the Mk 7 dispenser is filled with 247 Mk 118 bomblets and weighs 222kg. The Mk 118 bomblets are 316mm long including nose probe, have a body diameter of 48mm, a finspan of 45mm and weigh 0.61kg. Their warhead consists of a shaped charge containing 183g of high explosive. The bomblet is designed primarily as an anti-armour weapon for use against hard targets such as tanks, armoured carriers and gun emplacements.However, they are equally effective against soft targets such as parked aircraft, truck convoys and small ships. The nose probe contains an impact fuze that discriminates between hard and soft targets, foliage and camouflage.

Delivery is similar to that for a 225kg conventional bomb, and once clear of the aircraft and at the selected time the nose fuze system activates a linear shaped charge that splits the bombs' casing open releasing the bomblets or mines. These are dispersed over the target area by aerodynamic forces and descend to the ground. The size and shape of impact areas can be changed according to aircraft speed, altitude, dive angle and the dispenser opening time. In heavily defended areas the Mk 7 dispenser can be delivered at high speeds and at altitudes as low as 75m in level flight or 30m with pitch up delivery. A typical Mk 118 bomblet footprint covers an area of 4800m² if the Rockeye is released from 150m.

The Rockeye II system entered service with the US forces in the early 1970s and is still in operational use with the US and with more than ten other countries including Denmark and Sweden.

SPECIFICATIONS	Mk 6/7 Dispenser	Mk 118 bomblet
Length	2.34m	0.316m
Body diameter	335mm	48mm
Tailspan	0.44m closed 0.86m extended	0.045m
Lug spacing	356mm	n/a
Weight	222kg	0.61kg
Filling	247 Mk 118	0.183kg shaped charge



APPENDICES

GLOSSARY OF TERMS

The *Expert Flight Manual* contains a glossary of useful terms (pp. B9-C12). This glossary doesn't replace that one — however, this list from the USAF *Combat Aircraft Fundamentals 3-3* manual, and includes explanations you might not find elsewhere. You can use it to make your gaming experience more realistic, especially when in multiplayer combat.

NOTE: This glossary is a subset of unclassified terms found in MCM 3-1, Vol 1. MCM 3-1 should be considered the source in case of conflict.

AA. Aspect angle; the angle between the defender's flight path and the attacker's LOS, measured from the defender's 6:00.

Abort. A directive call to cease the action/event/attack/mission.

ACBT. Air combat training; a general term which includes (D)BFM, (D)ACM, and (D)ACT.

Acceleration Maneuver. An offensive or defensive maneuver, flown in the vertical plane, if possible, to increase or reduce distance from an objective. A low yo-yo is an acceleration maneuver.

ACM. Air combat maneuvers; training designed to achieve proficiency in element formation maneuvering and the coordinated application of BFM to achieve a simulated kill or effectively defend against one or more aircraft from a preplanned starting position.

ACT. Air combat tactics; training designed to practice element formation tactics against one or more aircraft from a BVR set up.

Action. A directive call to initiate the prebriefed attack sequence or maneuver.

Active. A radar missile utilizing autonomous guidance.

Adverse Yaw. The tendency of an aircraft to yaw away from the applied aileron.

Advisory Control. A radio monitor mode used when the controlling agency loses radar, shuts down radar to preclude attack, loses radar effectiveness due to countermeasures, or when the fighters are beyond radar coverage.

AHC. Advanced handling characteristics; training consisting of maneuvers throughout the entire flight envelope designed to familiarize the aircrew with different flight characteristics as they apply to aerial combat.

Air Refueling Time. Planned lapsed time from the ARCT until drop-off.

Alpha Check. Request for/confirmation of bearing and range to a specific point.

Anchor. Orbit about a specific point; ground track flown by tanker. During A/A, informative call indicating a turning engagement about a specific location.

Angels. Height of the aircraft in thousands of feet.

Angle-Off. A/A: the angle formed by the extension of the longitudinal axes of two aircraft as measured from the defender's 6:00. Also called track crossing angle. A/G: the angular difference between the approach heading and the attack heading during a pop-up attack.

AOA. Angle of attack; the angle between the wing mean chord line and the relative wind, expressed in degrees or cockpit units.

AOD. Aim-off distance; a specified distance to a point long of the target during diving deliveries. The velocity vector is placed at a specific AOD during the track-to-release portion of the delivery.

Apex. The peak altitude attained during a pop-up attack profile.

Apex/Alamo. A training term used to denote simulated launch of an enemy all-aspect radar missile.

Aphid/Archer. A training term used to denote launch of an enemy heat-seeking missile.

A-Pole. The distance between the launching aircraft and the target at the range an active radar missile begins terminal guidance.

Arcing. The use of cutoff to gain closure — flying a smaller turn circle inside the defender's flight path.

ARCP. Air refueling control point; the planned geographic point where the tanker and receiver complete the AR rendezvous.

ARCT. Air refueling control time; the planned time for tanker and receiver rendezvous over the ARCP.

ARIP. Air refueling initial point; a geographical point upstream from the ARCP, used to enter the refueling track/hold prior to the rendezvous.

Armament Safety Check. Cockpit armament switch checks to preclude inadvertent release/launch of ordnance ("Switches Safe").

ASL. Azimuth steering line; HUD symbology providing the pilot steering cues for A/G weapons employment.

ATF. Actual time of fall; the total time from ballistic weapons release to impact.

Attack Restriction. Ingress, target ID, ordnance delivery, or egress restrictions dictated by weather, terrain, friendly forces, political sensitivity, etc.

Authenticate. To request or provide a response for a coded challenge.

AUTO. Automatic, an A/G weapons delivery mode.

Autonomous. Aircrew is operating without the benefit or guidance from a controlling agency.

Bandit (Radar/Heat/Striker). Enemy aircraft and ordnance capability.

Base. A reference number used to indicate information such as heading, altitude, fuel state, etc. In the A/G delivery pattern, a position prior to the final attack heading.

Beam. A target aircraft with 07-11 left/right AA.

Belly Check. Momentary unloaded bank to check the blind side of a turning aircraft.

__ **Bent.** An informative call indicating the identified equipment is inoperative.

BFM. Basic fighter maneuvers; training designed to apply aircraft handling skills to gain proficiency in recognizing and solving range, closure, AA, angle-off, and turning room problems in relation to another aircraft. The objective of BFM is either to attain a position from which weapons are employed, deny the bandit a position from which he employs weapons, or to defeat weapons already employed by a bandit.

Bingo. Fuel state when RTB commences.

Blind. An informative call indicating loss of visual contact with friendly aircraft.

Blow Through. An informative call indicating the fighter aircraft continues straight through at the merge and does not turn with the target(s).

Bogey. Unidentified radar/visual contact.

Bogey Dope. A request for target information from GCI/AWACS.

Bone. A term indicating the formation remains in a racetrack-type holding pattern (with all wingman turns into lead); the desired exit formation is specified by lead.

Box. Target groups/contacts/formations in a square/offset square.

Bracket. Fighter element attack geometry which places aircraft on opposing sides of the target either laterally or vertically.

Break (Up/Down/Right/Left). A directive call, normally to the tanker, to perform an immediate maximum performance defensive turn in the direction indicated.

Breakaway. A directive call from tanker-to-receiver to maneuver so as to attain immediate horizontal/vertical/ nose-tail separation.

Broadcast Control. A method of control to pass target information to several aircraft by referencing a specific location (bullseye), series of locations, or grid system.

Broke Lock. An advisory call indicating loss of radar/IR lock-on.

Buddy Spike (position/azimuth/altitude). An informative call indicating reception of friendly AI RWR.

Bugout (Direction). A directive call to separate from the engagement in a specific direction with no intent to reengage.

Bullseye. Code word for a specific reference point from which the position of target aircraft are determined.

Bump/Bump-Up. A maneuver to acquire LOS to the target or laser designation.

Bunt. A crew coordination term indicating a pushover maneuver, as in a negative-G ridge crossing.

Burner. A directive call to select/deselect afterburner.

Buzzer. An informative call indicating electronic communications jamming.

Canopy Code. A technique to correlate visual references in the cockpit with radar target azimuth and elevation enhancing visual lookout and facilitating an early tally.

CAS. Close air support; an air combat mission in direct support of ground troops in contact with enemy forces (not a normal F-15E mission). Calibrated airspeed; indicated airspeed corrected for installation error.

CATA. Collision antenna train angle; the radar azimuth which places the target aircraft on a collision course with the fighter.

CDIP. Continuously displayed impact point; a visual A/G delivery mode.

Cell. Multiple tankers flying in formation.

CEM. Combined effects munition; a canistered bomblet anti-armor/personnel weapon; i.e., CBU-87.

CG. Center of gravity; a point along the horizontal (fore/aft) axis where the weight of an aircraft is balanced.

Chaff. Passive ECM deployed by an aircraft to obscure its radar return or break the lock of enemy radar systems. A directive call to dispense chaff. An informative call indicating chaff returns are detected.

Champagne. An attack of three distinct groups with two in front and one behind. The leading two groups attempt a bracket maneuver while the third group flies up the middle in a frontal assault.

Chattermark. A directive call to begin using briefed radio procedures to counter communications jamming.

Check (__Right/Left). A directive call to execute a hard turn the specified number of degrees and maintain the new heading.

Chicks. Known friendly fighters.

Christmas Tree. A directive call to turn on exterior lights momentarily to facilitate visual acquisition.

Cine Track. A low-G training maneuver employed to practice guns tracking.

Circle (Right/Left). A flight lead directive call to establish a defensive circular holding pattern for mutual support.

Clean. No radar contacts in the assigned area of responsibility.

Cleared. An informative call authorizing requested action. No engaged/support roles are assumed.

C_LMAX. Maximum coefficient of lift; occurs at the AOA where lift is maximum, creating the maximum turn rate and G for any flight condition.

Clock Code. A visual position description using the aircraft as a reference. The nose is 12:00; the tail is 6:00.

Close Control. A mode of control providing maximum weapons controller assistance in accomplishing the intercept. Assistance provided varies from only vectors to complete airspeed, heading, and altitude direction.

Closing. Range to the bandit/bogey/target is decreasing.

Closure. Relative velocity of one aircraft in relation to another.

Cold. Attack geometry resulting in a roll-out behind the target. A leg of the CAP point heading away from the anticipated threats.

Collision Course. A flight path along which an aircraft is directed, toward a point where the attacker and the defensive aircraft theoretically collide.

Combined. Multi-national.

Come Off (Direction). A directive call to maneuver as indicated to either regain mutual support or deconflict flight paths during the engaged/supporting role swap. Implies both tally and visual.

Comeback. A directive to reverse course.

Comm Jamming. An attempt to interrupt communications.

Commit. Fighter intent to engage/intercept. Weapons controller continues to provide information.

Comparison Diagram. A chart comparing turn rate, radius, and excess power for two different aircraft.

Composite Force Training. Scenarios employing multiple flights of different types of aircraft and missions.

Condition of Vulnerability. A condition which places the defender in the lethal envelope of the attacker's weapons system. It is possible for combatants to arrive at a mutual condition of vulnerability, normally during a head-on pass.

Contact. An informative call indicating a radar/IR target return at the stated position. Given in bearing, range, altitude (BRA), bullseye, or geographic references (geographic) format.

Continue. A directive call for an aircraft to continue the present maneuver for attack. Does not imply clearance to engage or expend ordnance.

Corner Velocity. Minimum airspeed at which the maximum allowable aircraft G is generated.

Cover. A directive call to assume the briefed support position and its associated responsibilities.

Crank. A call directing the F-pole maneuver; implies illuminating the target at radar gimbal limits.

Cross Turn. A 180° heading reversal by a flight with the aircraft turning toward one another.

Cutoff. A request/direction for the intercept of a target using cutoff geometry.

DACT. Dissimilar air combat tactics; ACT training flown with two different types of fighter aircraft (e.g., F-15E versus F-16C).

DB. Dive bomb; an A/G weapons release with a dive angle of 30° or greater.

Deadeye. Indication that the airborne laser designator is inoperative.

Defensive Maneuvering. Maneuvers designed to negate the attack/ordnance of another aircraft.

Defensive Spiral. A descending, accelerating spiral dive using high-G and continuous roll to negate an attack and gain lateral separation.

Deploy. A directive call for the flight to maneuver to the briefed position.

Designate. Use of aircraft systems to identify a ground objective/aircraft as a target for weapons employment.

DIL. Designated impact line; a HUD symbology line connecting the velocity vector and pipper for A/G CDIP bombing.

DIRECT. A manual A/G bombing mode used with the SUU-20/BDU-33 practice ordnance.

DMPI. Desired mean point of impact; a specific point of the target area in the center of a bomb train.

Dogleg. A short leg in an A/G radar bombing pattern prior to final used for HRM target mapping.

Downwind. A leg of the A/G radar bombing pattern opposite the final leg.

DR. Dead reckoning; a navigation technique using time, heading, and airspeed.

Drag. An aircraft maneuver to reduce AA to 60° or less.

Dry. An informative call during A/G munitions deliveries indicating no ordnance expended/no intent to release/release not authorized.

DTM. Data transfer module; a small solid-state memory component used to transfer mission data from the MSS to the aircraft avionics system.

Echelon. A call conveying groups/contacts/formation with wingmen placed 45° behind the leader's wingline.

ECM. Electronic countermeasures; actions taken to prevent or reduce the effective use of sensors/communications in the electromagnetic spectrum.

Egress. The outbound (exit) portion of an A/G attack profile.

Element. A flight of two aircraft.

Engaged. An call conveying maneuvering/request to maneuver with the intent of achieving a kill. Assumes tally if no bearing/range information passed.

Engagement. Visual maneuvers by opponent attempting to achieve/defeat weapons employment positions.

E-Pole. The minimum range from the bandit a defender must drag to kinematically defeat any missile the bandit has launched or is launching.

ESL. Elevation steering line; a HUD symbol providing pitch/G-loading cues during the pull-up maneuver for A/G weapons delivery.

Extend. A directive call to gain energy and increase separation, with the possible option of reengaging at a later time.

Faded. An informative call relating the previous radar contact is lost.

Faker. A training exercise term denoting aircraft in an adversary role.

Fast. Target speed estimated greater than 600 knots GS/M 1.0.

FEBA. Forward edge of the battle area; the boundary between opposing ground forces.

FENCE Check. Cockpit switch actions/checks accomplished to prepare the flight/aircraft for simulated or actual combat prior to entering enemy territory.

Fighter Turn-On. An AR rendezvous with the fighter completing the intercept with a turn to the tanker's heading.

Final. The last leg approaching the target during an A/G attack profile. A radio call made when on the final leg.

Flank. A target with a stable AA of 12-15 L/R. A call directing the flight to maneuver to present this aspect.

Flare. A pyrotechnic device dispensed to defeat IR missiles. An informative call when flares are detected. A directive call to employ flares.

Flash. Momentary activation of a specific IFF.

Float. A directive call to expand the formation laterally within visual limits to maintain radar contact or prepare for a defensive response.

FLOT. Forward line of troops; the leading edge of friendly ground forces, behind the FEBA.

Flush. Precautionary launch of aircraft for survival. A 3/9 line overshoot during BFM.

Fox. An informative call for missile launch: 1-Radar, 2-IR, or 3-AMRAAM.

F-Pole. A maneuver to maximize the distance between the launching aircraft and the target at missile impact.

Frag. Fragmentary ATO, applicable to one unit or weapons system. Vertical, lateral, and duration limits of ordinance fragmentation.

Friendly. An informative call identifying friendly aircraft.

FSCL. Fire support coordination line; a boundary established by the ground forces commander to coordinate attacks on enemy ground targets, primarily to preclude fratricide.

Furball. A turning fight involving multiple aircraft.

Gadget. Fire control radar.

Gimbals (Direction). A call to inform leader the radar target is approaching azimuth limits in the direction stated.

Go. A directive to acknowledge a call and go to the briefed channel/frequency.

Go Active. A directive call to initiate the briefed HAVE QUICK radio procedures.

Go Secure. A directive call to initiate the briefed KY-58 radio procedures.

Gorilla. A large force of undetermined size/formation.

Green. A call indicating the direction determined to be clearest of enemy A/A activity. Secure (KY-58) radio communications.

Group. Radar targets within approximately 3nm of each other.

GS. Ground speed; TAS corrected for wind.

Guns. A/A or A/S gunshot.

Hard (Direction). A directive call to begin a high-G energy sustaining turn in the direction indicated.

HAVE QUICK. A UHF radio feature which counters communications jamming through frequency-hopping.

HCA. Heading crossing angle; the angle between the fighter and target heading.

HD. High drag; (retarded) A/G ordnance.

Head. Target AA of 16-18 (H).

Heads Down. An informative crew coordination call indicating the aircrew member is working systems in-cockpit and is unable to perform clearing/ monitoring duties.

Heater. A slang term for an IR missile.

High. An informative call indicating target altitude above 30,000ft MSL.

High Aspect BFM. A/A training from a neutral setup with aircraft approaching one another head-on. Stresses the use of lead turns and all-aspect missiles.

Hit. A radar return in the search mode (A/A). Bomb impact within lethal distance of a ground target (A/G).

Hook. A directive call to perform a 180° in-place turn.

Hostile. Target aircraft positively identified as enemy IAW ATO SPINS/ROE.

Hot. A/A: a GCI informative call the target is heading toward the fighters. Intercept geometry which positions the fighters in front of the target. The leg of a CAP heading toward the anticipated threats. A/G: ordnance employment is authorized, anticipated, or completed.

Hound Dog. An informative call from the supporting fighter to the engaged fighter within a visual arena that a shot opportunity exists. This call implies a tally and visual exist.

Hung. A/A or A/G weapon launch/release commanded, but the ordnance remained on the aircraft.

Hunter-Killer. A flight of mixed Wild Weasel and A/G fighters utilized in the enemy SAM radar destruction role.

ID. A directive call to intercept and identify the target.

Immelmann. A low-to-high vertical intercept.

In. A call during the A/G dive bombing pattern when turning to final, requesting clearance/announcing intent to drop.

Inadvertent Release. An aircraft system malfunction resulting in launch/release of ordnance.

INFLTREP. Inflight report; a call to the controlling agency to relay mission success, aircraft status, target weather, etc.

Ingress. The inbound (entry) portion of an A/G attack profile.

Intercept. That phase of A/A mission between commit and engagement. The attacker uses his onboard radar, GCI, and maneuvers to place his aircraft in a position of advantage to employ ordnance, VED, or visually engage the target.

Interleaved. Radar search mode alternating medium and high PRF waveforms.

IP. Initial point; a radar/visually significant ground reference for final A/G attack maneuvering.

IPP. Initial pipper placement; a technique used in manual A/G bombing to achieve proper delivery parameters by placing the pipper a specific distance short of the target while positioned at the roll-out point.

Jinking Maneuver. An unpredictable maneuver to quickly change the aircraft plane-of-motion to defeat a gun shot or missile already in flight.

JMEM. Joint munitions effectiveness manual; a reference document used to determine the best weapons and tactics to employ against specific target types.

Joint. US/multi-service.

Joker. A specific fuel state above Bingo at which the separation/bugout maneuver is initiated.

Judy. An informative call to the weapons controller indicating the aircrew assumes responsibility for heading, altitude, and airspeed during the intercept. It requires radar/visual contact.

Kill. A directive call to commit against an airborne target with clearance to fire. In a training situation, an informative call indicating kill criteria are achieved.

LAB. Low angle bomb; an A/G diving delivery up to 10°. Commonly used for HD weapons releases.

Ladder. Three or more groups/contacts/formations in trail.

Lag. An attacking aircraft's pursuit path to a point behind the target aircraft (nose pointed behind the target).

LALD. Low angle low drag; an A/G diving delivery with 10-30° of dive. Commonly used for slick weapons releases.

LD. Laydown; an A/G level weapons delivery.

Lead. An attacking aircraft's pursuit path to a point in front of the target (nose pointed in front of the target).

Lethal Envelope. The envelope within which the parameters are met for successful employment of a munition by a particular weapons system.

Lift Vector. A vertical plane extending up through the top of the canopy, perpendicular to the aircraft's wings.

Line Abreast. Two groups/contacts/formations/aircraft side-by-side.

Locked. An informative call made with a BRA report; this call does not assume a sort is accomplished.

LOS. Line-of-sight; a straight line between aircrew member's eye or sensor directly to an objective.

LOS Rate. A rate of movement across the canopy/HUD by an air/ground objective.

Low. An informative call advising target altitude is below 10,000ft AGL.

Lufberry. A circular, stagnated "1v1" A/A fight with neither aircraft having an advantage.

MAD. Minimum approach distance; the minimum planned range to an A/G target during an LRDT attack escape maneuver (within maximum ballistic range of the ordnance, yet outside threat range).

Maneuverability. The ability of an aircraft to change direction and magnitude of the velocity vector described in values of turn rate/radius, G-loading, and duration.

MAP. Minimum attack perimeter; the minimum planned distance from an A/G target to begin tracking during a pop-up attack (allows for a given amount of tracking time and recovery above the frag envelope).

Marking. Leaving contrails or otherwise marking the aircraft's position.

Maverick. Nickname for a terminally-guided A/G missile (AGM-65) which utilizes either IR or TV sensors to track the target.

Maximum Performance. The best possible G/turn rate performance within aircraft limits.

Maximum Rate Turn. The turn at which the maximum number of degrees per second turn rate is achieved.

Medium. An informative call advising target altitude is between 10,000ft AGL and 30,000ft MSL.

Merged. An informative call indicating friendly and target radar returns are grouped together on the weapons controller's radar scope. The returns are too close to break out individually, but are all within visual range.

Mickey. A Have Quick time-of-day signal.

Midnight. An informative call indicating GCI/AWACS assistance is no longer available.

MiG. Common nickname for Soviet designed fighter aircraft.

Military Crest. A vertical position along a hill or ridgeline two-thirds up from base-to-summit, used as a terrain masking reference.

Mixed Force. Employment of a single flight composed of different types of aircraft, performing the same tactical role, under the direction of a single flight leader.

Mort. Mortality; a state of being dead. An informative radio call.

MSL. Mean sea level.

MSS. Mission support system; a computer system used for route and weapons planning for F-15E missions as well as loading the DTM.

Mud (Position). An informative interflight call indicating an RWR ground threat is displayed, normally followed by clock position.

Music. Electronic radar jamming.

Mutual Support. The combined efforts of two or more aircraft to provide visual/radar lookout to maximize the group's firepower and survivability.

Naked. An informative call indicating no RWR indications observed — opposite of "Spike."

Negative. A directive call in response to a request to engage — No.

No Joy. An informative call indicating the aircrew does not have visual contact with the bandit, the opposite of "tally."

Notch. An all-aspect missile defensive maneuver to place the threat radar/missile near a beam aspect.

Observation. A formation position on the tanker's wing during AR operations.

Off (Direction). An informative call the attack is complete and the flight is repositioning in the stated direction.

Off Station. An informative call indicating the flight is not in the CAP/hold position or the tanker is not in the AR track.

Offensive Maneuvering. Maneuvers against an A/A target to position the aircraft within valid weapons parameters.

Offset. An informative call indicating to maneuver in the direction called (with reference to the target; high/low/left/right).

On Station. An informative call indicating the flight is at the CAP/hold position, ready for mission employment. The tanker is established in the refueling track.

Ops Check. A periodic check of fuel quantity/balance and other aircraft systems. A directive call to perform the appropriate checks.

Overshoot. The attacker is flying through the defender's 3/9 line from behind during an A/A engagement. A wingman flying beyond the planned formation rejoin position.

Package. A geographically separated collection of groups/contacts.

Padlocked. An informative call indicating the aircrew cannot take their eyes off the target without a significant risk of losing tally.

Paint. An informative call indicating receiving friendly AAI returns.

PD. Probability of damage; a JMEMs estimation of the level of destruction to a specific target type using specific munitions/weapons systems/parameters.

PH. Probability of hit; a JMEMs estimation of the weapon impacting/fuzing within the lethal envelope.

Picture. A request to a weapons controller for a situation briefing, including real-time information pertinent to the flight's specific mission.

PIREP. Pilot report; a radio call to the controlling agency to relay weather conditions inflight.

Pitch (Direction). A directive call to initiate a climbing heading reversal in the direction stated.

PK. Probability of kill; a JMEMs estimation of the number/effectiveness of weapons required to achieve a specific level of destruction by target type.

Playtime. The amount of time an aircraft is able to remain on station.

Point Parallel. An AR rendezvous procedure in which the fighter maintains level flight along a set course and the tanker turns to roll out in front of the receivers.

Popeye. The aircraft is in IMC.

Post-Hole. An aggressive descending spiral drag maneuver to break the enemy's radar lock.

Pre-Contact. An AR position just behind the boom. A stabilized position prior to contact and actual refueling.

Press. A directive call to continue the attack; mutual support is maintained. Appropriate engaged/supporting roles are assumed.

Primary Force. The flight(s) being protected/escorted.

Ps. Specific excess power; a term used to compare maneuverability of different aircraft under similar conditions, expressed in feet per second.

Pump. A directive call to perform a pre-briefed sequential maneuver to stop forward relative motion while maintaining SA on the threat.

PUP. Pull-up point; a point short of the target during an A/G pop-up or loft attack where the maneuver is initiated.

Pure. A pursuit course with the attacker continually pointing directly at the target.

Push. A directive call to switch to new frequency without acknowledgment.

Quarter-Plane. An aggressive vertical maneuver perpendicular to the target's plane-of-motion employed to prevent a 3/9 line overshoot.

RA. Maximum aerodynamic missile range.

RAA. Recovery abort altitude.

Ranch House (Altitude). A directive/information call indicating the fighters are to return to the CAP point.

RAP. Release aim point; a wind-corrected point on the ground where the pipper is placed during manual bombing to impact the bomb on target.

RAPE. Release aim point extended; wind-corrected point on the ground where the pipper is initially aimed at rollout, allowing for aircraft drift during tracking.

Raygun (Position/Azimuth/Altitude). Radar lock-on to an unknown aircraft. Request "Buddy Spike/Naked" reply.

Relative Wind. Airflow across the aircraft's wings, exactly opposite the aircraft flight path.

Rifle. AGM-65 launch informative call.

RMAX1. Maximum launch range for a radar missile (allows for no maneuvering by the target).

RMAX2. Maximum launch range for a radar missile (accounts for limited target maneuvers).

RMIN. Minimum missile launch range for turn required, fuzing, etc.

Rockeye. Anti-armor cluster bomb unit ordnance; Mk 20.

Rocks. Informative crew coordination call for terrain avoidance.

ROE. Rules of engagement; specific restrictions on engagement/destruction of air/ground targets, outlined in the ATO SPINS.

Rolling. An informative crew coordination call when maneuvering close to the ground.

RTR. Range turn-and-run; a maximum launch range for a radar missile.

Rumba. Ownship maneuvering and ranging (OMAR).

Run. A directive to perform a defensive maneuver and place the threat (radar/missile) on the tail.

SA. Situational awareness; cognizance of the total aerial arena picture, such as: aircraft parameters, target location, flight position, timing, threats, etc.

SAFE Area. Selected area for evasion; a designated area in enemy territory to evade capture and wait for a rescue.

SAM. Surface-to-air missile. An informative call for visual acquisition of a SAM launch.

Sandwich. A situation where one aircraft/element is caught between enemy aircraft/elements.

Sanitize. A directive call to clear an assigned area with the radar searching for additional threats.

Saunter. Fly at best endurance.

Scissors. Defensive maneuvering utilizing a succession of turn reversals attempting to achieve an offensive posture following an attacker's overshoot.

SCL. Set clearance limit; a selected altitude AGL for TFR flight. Standard conventional load; a specific number/type of weapons in various combinations.

Scramble. Launch the aircraft as soon as possible.

SEAD. Suppression of enemy air defense; a specific mission to conduct attacks directly on ground-based threat sites.

Semi-Active. A missile/bomb guidance system where the receiver utilizes radiation/reflection from the target (target has been illuminated by another source).

Separate. A directive call to extend out of a specific A/A engagement.

Separation. Vertical/horizontal distance between an attacker and defender. Action to increase this distance.

Shackle. A single, simultaneous weave by two formation members to adjust formation position.

Shadow. Follow the indicated target.

Shift. A directive to illuminate a second target with laser.

Shooter. The aircraft designated to employ ordnance.

Shotgun. An informative call relating the launch of an anti-radiation missile (ARM) by Wild Weasel aircraft.

Sidewinder. AIM-9 IR missile.

Skip It. A directive call to veto a previous fighter commit/terminate the intercept/engagement.

Slice. A directive call to initiate a maximum performance descending heading reversal in the direction stated.

Slow. An informative call indicating target airspeed is less than 300 knots GS.

Smash. A combination of kinetic (airspeed) and potential (altitude) energy.

Snap. A directive call to turn immediately to the target group described.

Snapshot. A high LOS gunshot.

Sort. An informative interflight call indicating criteria are met to ensure flight members have separate radar contacts.

Sparrow. AIM-7 semi-active radar missile.

Spike. An informative call indicating enemy AI RWR is being received.

SPINS. Special instructions; a special section of the ATO which outlines ROE, airspace restrictions, ID criteria, etc.

Spitter. An aircraft which has departed the engagement.

Splash. A/A: target destroyed. A/G: weapons impact.

Split Plane Maneuvering. Aircraft or elements maneuvering in relation to one another, but in different planes-of-motion/altitudes.

Split-S. A pure vertical descending heading reversal.

Stack. Two or more aircraft/elements with vertical separation in relation to each other.

Status. A request call for the individual aircrew's tactical situation — normally offensive, defensive, or neutral. Usually accompanied with position, altitude, turn direction, etc. information.

Stinger. A tactical formation with one aircraft in trail.

Stranger. An unidentified aircraft which is not a mission participant.

Strangle. A directive call to disable the IFF.

Strobe. An informative call conveying radar noise jamming.

Sunrise. An informative call indicating GCI/AWACS is operational, opposite of "midnight."

Supporting. The aircraft not currently engaged, either the leader or wingman.

Switch/Switched. An informative call the attacker has switched from one target to another.

Systems. A crew coordination call indicating an aircrew member is working in-cockpit systems, and cannot perform normal clearing/monitoring duties.

Tactical Control. A mode of control similar to close control. The weapons controller provides all target information, but does not provide fighter headings or altitudes.

Tally. An informative call conveying visual contact with the bandit; the opposite of "No Joy."

Target. A/A: a directive call to specify sorting responsibility. A/G: a ground objective designated by the system for attack.

TAS. True airspeed; CAS corrected for temperature and altitude. Actual aircraft speed through the air mass.

Threat (Direction). An informative call from the weapons controller indicating an untargeted bogey is within 10nm of a friendly aircraft, in the direction called.

Tied. An informative interflight call relating trailing wingmen have radar contact on the aircraft ahead during a trail departure/recovery.

Tracking. A stabilized gun solution.

Trail. A tactical formation of aircraft following the same ground track.

Trailer. The last aircraft in a formation.

Trashed. An informative call indicating a missile in flight has been defeated.

Tumbleweed. An informative call conveying very limited SA, no joy, blind, clean, etc. — a request for information.

Turn Rate. Turn performance of an aircraft, commonly expressed in degrees of heading change per second.

Uniform. UHF radio identifier.

Unintentional Release. Weapon release/launch through aircrew error.

Up. An informative call during an A/G pop-up attack, made as the pull-up is initiated.

Vc. Velocity of closure; the combined velocity of one aircraft in relation to another, usually expressed as positive or negative.

Velocity Vector. Actual flight path of the aircraft, depicted by the HUD velocity vector symbol.

Vertical Rolling Scissors. A defensive rolling-descending maneuver applied to achieve an offensive advantage.

Very Low. An informative call from a weapons controller relating the target is below 300ft AGL.

Vic. Three aircraft/contacts/groups with the single closest in range (relative to the opponent) and the element in trail.

Visual. An informative call conveying visual contact with other formation members/friendly aircraft. The opposite of "blind."

Wall. Three or more aircraft/contacts/groups in a line abreast formation.

Weapons System. A combination of the aircraft, avionics, crew, and ordnance.

Weave. A continuous crossing of flight paths by formation members.

Wedge. Tactical formation of two or more aircraft with the single in front and the others displaced laterally on either side, behind the leader's wingline.

Weeds. An informative call indicating the aircraft are operating very close to the ground.

Wet. An informative call relating ordnance was expended.

What Luck. A request for mission results.

What State. A request for the aircraft fuel/armament status, sequentially stated as: " _ radar, __ heat, gun, _ fuel (pounds)."

Wilco. Will comply.

Wild Weasel. A specialized radar defense suppression aircraft.

Winchester. An informative call conveying no ordnance remaining.

Yo-Yo. A vertical BFM maneuver employed to increase or decrease the attacker's rate of closure.

ZCL. Zero command line; a line on TFR E-Scope depicting the limit of terrain returns for correct TFR flight.

IN-FLIGHT CALLS

This jargon glossary defines phrases that your wingman and other flights use during missions. Additional terminology is mentioned in the *Expert Flight Manual* (p. B.9) and in the **3-3 Glossary** (p. 298).

Ambiguous returns, standby. JSTARS can't see a target because it is out of range or out of radar LOS.

Available for tasking. Your "check-in" message to JSTARS.

Bearing. Position measured in degrees (0 is due north, 90 is due east, 180 is due south, 270 is due west).

Boom Boom! Out go the lights! Your bomb hit the designated target point.

Ceiling. Upward visibility, either unlimited (**ceiling unlimited**) or given in thousands of feet of altitude (**ceiling angels ...**).

Center your steering. You're off-course (right or left) during a bombing run and need to steer toward the ASL.

Check external lights off. WSO requests that you turn off external lights prior to crossing into enemy territory.

Check fire! You've hit friendly troops, and the forward air controller orders you to hold your fire.

Check In/Out. Flight's radio call to JSTARS aircraft, letting the JSTARS know it's in the area.

Cleared to patrol as fragged. JSTARS has no targets for you at this time, and you are free to search for targets.

Converting to our six! An enemy aircraft is tailing you.

Copy. Radio message received.

Do you read me? Request for radio acknowledgment.

Drag (Left/Right). Request for flight aircraft to lead your current A/A target to the left or right, so you can get a better shot angle at him.

E-Mis selected. WSO has engaged EMIS LMT during refueling to stop radar emissions.

Enemy chopper. An enemy helicopter has been spotted.

Enemy striker. An enemy strike aircraft has been spotted.

Engage/Engaged. Another aircraft has assumed an offensive or defensive posture against an enemy threat (**engaged defensive at this time/engaged defensive SAM/engaged offensive).**

Firing cannon — Jink now! WSO requests that you take immediate, evasive action against enemy gunfire.

Gadget bent. Radar is inoperative.

Going away. Your target is flying away from you.

Going cold. Wingman has turned to the "cold" side (away from expected enemies) during a CAP mission.

Going hot. Wingman has turned to the "hot" side (toward expected enemies) during a CAP mission.

Going vertical! Your target is going high relative to your position.

Gomers spotted, engaging. An aircraft in your flight has sighted an enemy ground units and initiated an attack.

Guns! You're firing your aircraft's guns.

Heading for the weeds! Your target is going low relative to your position.

Heads up! A friendly aircraft has issued a general alert.

Heat. Indicates how many IR missiles you have remaining (preceded by a number, i.e., "Two Heat!").

Helo. Unidentified helicopter spotted.

Hold for traffic/landing traffic. Request for you to delay takeoff/landing until friendly air traffic clears.

Hydraulics bent. Hydraulic system has taken damage.

IFF set. Friendly aircraft interrogation frequency has been set.

Laser off/on. AN/AAQ-14 laser is inactive/active.

Launch! Launch! A missile has been launched at your aircraft.

Losing lase, watch your steering. You're off-course during a laser-guided bombing run and the laser beam is in danger of being masked by the aircraft.

Maverick! Wingman has fired a Maverick missile (or, he may call "Rifle").

MAYDAY! A friendly aircraft is in trouble and in danger of crashing.

Missile Launch/missiles inbound! WSO has incoming missiles on TEWS.

Movers. JSTARS have spotted moving ground targets.

Mud Lock on. A ground radar has locked onto your aircraft.

Music On/Off. Jammers active/inactive.

Offload complete, disconnecting. Refueling is complete.

On (cleared on). You have permission to begin a refueling approach.

Orbit Here. You've ordered a friendly aircraft to assume a circular flight pattern at its current location.

Pacs is out! Your Programmable Armament Control Set (PACS) is damaged; you are unable to fire missiles/drop bombs.

Pod is masked, lost designation. You've masked the laser beam and lost the laser designation on the target.

Precontact ready. You're in precontact position with a refueling tanker and are ready to connect.

Rejoin Flight. You've ordered a friendly aircraft to join your formation.

Rifle. Wingman has fired a Maverick missile (or, he may call "Maverick").

RTB. Request for you to return to base.

Sandy inbound/SAR package enroute. A friendly search-and-rescue team is enroute.

Sanitize Left/Right. You've ordered a friendly aircraft to fly 90° to left or right and use radar to find and engage targets.

SAR scramble. Request for a search-and-rescue team.

Shack. Your bomb successfully hit the designated target point.

Spike. WSO has spotted radar activity on the TEWS.

Buddy Spike. A friendly radar has detected your aircraft.
Mud Spike. A ground radar has detected your aircraft.
Spike GCI. A Ground Control Intercept (ground-based early warning radar system) has detected your aircraft.
Spike MiG. An enemy fighter's radar has detected your aircraft.
Spike SAM. A SAM radar has detected your aircraft.
Spike Triple A. An AAA "Triple-A" site radar has detected your aircraft.

Split High/Low. Request for your wingman to fly above/below an enemy aircraft.

Striker. WSO has spotted an enemy strike aircraft.

Strobe. An enemy aircraft is emitting jamming signals.

Tally. Friendly aircraft has made a visual sighting.

Tally bandit. Friendly aircraft has spotted a bandit.
Tally on you. Friendly escort aircraft has spotted your aircraft.
Tally your bandit. Friendly aircraft has spotted an aircraft that is engaging you.

Targets in sight, in hot. Friendly aircraft has spotted its assigned ground targets and is commencing an attack.

Touching down at LZ now. Friendly helicopter has touched down at specific landing zone.

Transmitting new coordinates on dolly. Updated waypoints are being sent to your aircraft's computer via secure data link.

Vector/vectoring. New navigational coordinates are being sent to your aircraft or other friendly aircraft.

Weeds. Enemy aircraft at low altitudes.

Wilco. Friendly aircraft will comply with your request.

Winchester. You are out of missiles/bombs.

Zero gun. You are out of gun ammo.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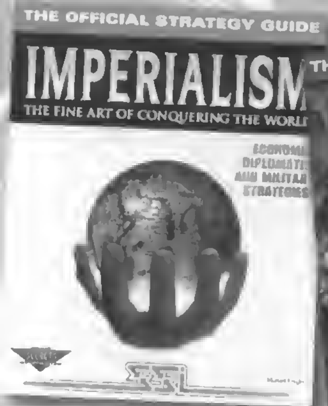

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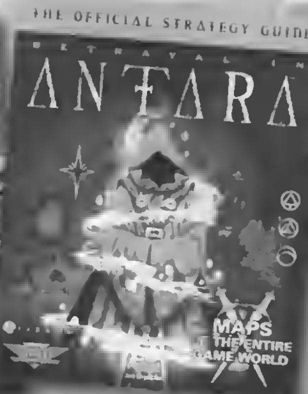

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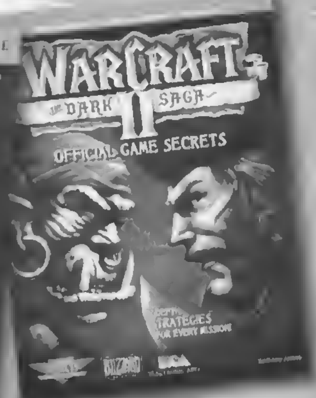

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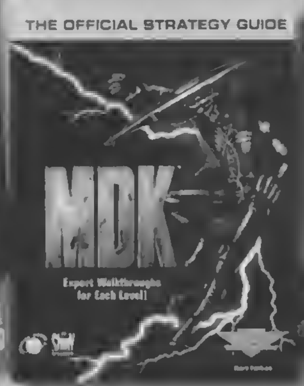

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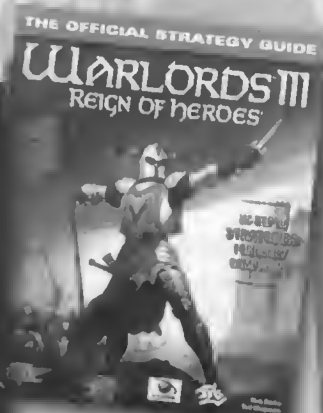

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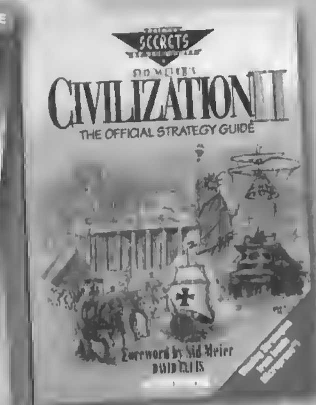

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